A - Five-Year Fuels Treatment Plan

Table A-1 – Five-Year Fuels Treatment Plan

FMU	Year	Project Name	Type of Treatment	Acres	Notes
Fiscal Year 2004					
Middle Fork	FY04	Ash Mountain/ Hospital Rock	Fire	25	These are annual maintenance burns conducted around the Ash Mountain Headquarter complex within the Middle Fork FMU.
Grant Grove	FY04	Buena Vista	Fire	272	This is a restoration burn in the Redwood Mountain area of the Grant Grove FMU. This project will form an anchor point for additional treatment projects in the area.
North Fork	FY04	Cabin Meadow	Fire	441	This is a restoration burn within the North Fork FMU which will protect the developed area around Dorst campground.
Grant Grove	FY04	Grant E	Fire	422	This is a restoration burn within the Grant Grove FMU.
Grant Grove	FY04	Grant West I	Fire	129	This is a maintenance burn within the Grant Grove FMU.
Marble Fork	FY04	Hazelwood	Fire	270	This is a combination maintenance and restoration burn within the Marble Fork FMU.
East Fork	FY04	Highbridge	Fire	1,466	This is a restoration burn within the East Fork FMU to protect the developed area around Silver City.
Cedar Grove	FY04	Lewis Creek	Fire	1,000	This is a combination maintenance and restoration burn within the Sierra Crest FMU.
Middle Fork	FY04	Bearpaw	Mechanical	8	This is a mechanical project building off previous years treatments around the developed area in Bear Paw.
Cedar Grove	FY04	Cedar Grove	Mechanical	10	This is a mechanical project around the developed area within the Cedar Grove FMU. Treatment area will be approximately 10 acres within the block on the map.
Marble Fork	FY04	Lodgepole	Mechanical	10	This is a mechanical project around the Lodgepole developed area within the Marble Fork FMU. Treatment area will be approximately 10 acres within the block on the map.
North Fork	FY04	Crystal Cave planning	Mechanical		This is the planning for a mechanical project around the Crystal Cave developed area within the North Fork FMU.
Kern Canyon	FY04	Kern Ranger Station pile burning	Mechanical	5	This is to burn the piles created in FY03 around the historic Kern Ranger Station due to the threat from the McNally Fire.
Marble Fork	FY04	Lodgepole pile burning	Mechanical	10	This is to burn the piles created by the FY03 mechanical project around the Lodgepole developed area within the Marble Fork FMU.
East Fork	FY04	Oriole Lake pile burning	Mechanical	20	This is to burn the piles created by the FY03 mechanical project around the Oriole Lake developed area within the East Fork FMU.
Grant Grove	FY04	Wilsonia WUI pile burning	Mechanical	83	This is the continuation of a mechanical project around the Wilsonia development within the Grant Grove FMU.
Fiscal Year 2005					
Middle	FY05	Ash Mountain/	Fire	25	These are annual maintenance burns conducted

Fork		Hospital Rock			around the Ash Mountain Headquarter complex within the Middle Fork FMU.
North Fork	FY05	Dorst	Fire	194	This restoration burn builds off the Cabin Meadow unit to protect the development around the Dorst campground within the North Fork FMU.
Marble Fork	FY05	East Halstead	Fire	1,680	This is a maintenance burn within the Marble Fork FMU.
East Fork	FY05	Highbridge East	Fire	1,031	This is a restoration burn within the East Fork FMU.
Cedar Grove	FY05	Lewis Creek East	Fire	1,480	This is a combination maintenance and restoration burn within the Sierra Crest FMU.
Grant Grove	FY05	North Boundary	Fire	280	This is a restoration burn within the Grant Grove FMU.
Grant Grove	FY05	North Grove	Fire	63	This maintenance burn builds off previous burned units within the Grant Grove FMU.
Marble Fork	FY05	Ski Lift	Fire	316	This is a restoration burn within the Marble Fork FMU.
Grant Grove	FY05	Upper Redwood	Fire	631	This restoration burn builds off the Buena Vista unit in the Redwood Mountain area of the Grant Grove FMU.
Middle Fork	FY05	Bearpaw	Mechanical	8	This is a mechanical project building off previous years treatments around the developed area in Bear Paw.
Cedar Grove	FY05	Cedar Grove	Mechanical	10	This is a mechanical project around the developed area within the Cedar Grove FMU. Treatment area will be approximately 10 acres within the block on the map.
North Fork	FY05	Crystal Cave	Mechanical	5	This is a mechanical project around the Crystal Cave developed area within the North Fork FMU.
Marble Fork	FY05	Lodgepole	Mechanical	10	This is a mechanical project around the Lodgepole developed area within the Marble Fork FMU. Treatment area will be approximately 10 acres within the block on the map.
East Fork	FY05	Silver City	Mechanical	20	This is a continuation of creating defensible around the Silver City developed area.
Middle Fork	FY05	Bearpaw pile burning	Mechanical	8	This is to burn the piles created by the FY04 mechanical project around the Bearpaw developed area within the Middle Fork FMU.
Cedar Grove	FY05	Cedar Grove pile burning	Mechanical	10	This is to burn the piles created by the FY04 mechanical project around the developed area within the Cedar Grove FMU.
Marble Fork	FY05	Lodgepole pile burning	Mechanical	10	This is to burn the piles created by the FY04 mechanical project around the Lodgepole developed area within the Marble Fork FMU.
Middle Fork	FY05	Redwood Cabin planning	Mechanical		This is to plan a mechanical project around the Redwood Cabin area within the Middle Fork FMU.
Fiscal Year 2006					
Middle Fork	FY06	Ash Mountain/ Hospital Rock	Fire	25	These are annual maintenance burns conducted around the Ash Mountain Headquarter complex within the Middle Fork FMU.
East Fork	FY06	Deer Creek East	Fire	941	This maintenance burn builds off the East Fork unit within the East Fork FMU.
East Fork	FY06	Fowler Creek	Fire	571	This restoration burn builds off the Mosquito unit within the East Fork FMU.
Grant Grove	FY06	Grant West II	Fire	214	This is a maintenance burn within the Grant Grove FMU.
Grant Grove	FY06	Hart	Fire	624	This restoration burn builds off previous burned units in the Redwood Mountain area of the Grant Grove FMU.

Marble Fork	FY06	Long Meadow	Fire	273	This restoration burn builds off the Ski Lift unit within the Marble Fork FMU.
North Fork	FY06	Lost Grove I	Fire	618	This restoration burn builds off the Cabin Meadow and Dorst units to protect the Dorst campground within the North Fork FMU.
Grant Grove	FY06	Pan Point	Fire	437	This is a combination restoration and maintenance burn within the Grant Grove FMU. This is a joint project with the USFS.
Sierra Crest	FY06	Sentinel Dome	Fire	1,430	This is a restoration burn within the Cedar Grove FMU.
Marble Fork	FY06	Suwanee Grove	Fire	1,848	This maintenance burn builds off the East Halstead unit within the Marble Fork FMU.
Cedar Grove	FY06	Cedar Grove	Mechanical	10	This is a mechanical project around the developed area within the Cedar Grove FMU. Treatment area will be approximately 10 acres within the block on the map.
North Fork	FY06	Crystal Cave	Mechanical	5	This is a mechanical project around the Crystal Cave developed area within the North Fork FMU.
Marble Fork	FY06	Lodgepole	Mechanical	10	This is a mechanical project around the Lodgepole developed area within the Marble Fork FMU. Treatment area will be approximately 10 acres within the block on the map.
Middle Fork	FY06	Redwood Cabin	Mechanical	6	This is a mechanical project around the Redwood Cabin area within the Middle Fork FMU.
Middle Fork	FY06	Bearpaw pile burning	Mechanical	8	This is to burn the piles created by the FY05 mechanical project around the Bearpaw developed area within the Middle Fork FMU.
Cedar Grove	FY06	Cedar Grove pile burning	Mechanical	10	This is to burn the piles created by the FY05 mechanical project around the developed area within the Cedar Grove FMU.
North Fork	FY06	Crystal Cave pile burning	Mechanical	5	This is to burn the piles created by the FY05 mechanical project around the Crystal Cave developed area within the North Fork FMU.
Marble Fork	FY06	Lodgepole pile burning	Mechanical	10	This is to burn the piles created by the FY05 mechanical project around the Lodgepole developed area within the Marble Fork FMU.
East Fork	FY06	Silver City pile burning	Mechanical	20	This is to burn the piles created by the FY05 mechanical project around the Silver City developed area within the East Fork FMU.
South Fork	FY06	Dillonwood planning	Fire		This is to plan an interagency (USFS, CDF) burn in the Dillonwood area of the South Fork FMU.
Fiscal Year 2007					
Middle Fork	FY07	Ash Mountain/ Hospital Rock	Fire	25	These are annual maintenance burns conducted around the Ash Mountain Headquarter complex within the Middle Fork FMU.
Grant Grove	FY06	Big Stump East	Fire	133	This is a restoration burn within the Grant Grove FMU. There may be significant cultural resources present in this unit.
South Fork	FY07	Dillonwood	Fire	TBA	This is an interagency (USFS, CDF) burn in the Dillonwood area of the South Fork FMU. Acreage to be determined during the planning phase.
Grant Grove	FY07	Ella	Fire	166	This maintenance burn builds off the North Grove unit within the Grant Grove FMU.
Sierra Crest	FY07	North Dome	Fire	3,335	This is a restoration burn within the Sierra Crest FMU.
Grant Grove	FY07	Redwood	Fire	768	This restoration burn builds off the previously burned units in the Redwood Mountain area of the Grant Grove FMU.
East Fork	FY07	Redwood Creek	Fire	742	This restoration burn builds off previously burned

					units within the East Fork FMU.
East Fork	FY07	Silver	Fire	253	This is a restoration burn within the East Fork FMU.
Middle Fork	FY07	Upper Crescent Creek	Fire	334	This is a restoration burn within the Middle Fork FMU.
Marble Fork	FY07	Wall Spring	Fire	168	This is a restoration burn within the Marble Fork FMU.
Cedar Grove	FY07	West Sentinel	Fire	2,641	This restoration burn builds off the Sentinel Dome unit within the Cedar Grove FMU.
Cedar Grove	FY07	Cedar Grove	Mechanical	10	This is a mechanical project around the developed area within the Cedar Grove FMU. Treatment area will be approximately 10 acres within the block on the map.
Marble Fork	FY07	Lodgepole	Mechanical	10	This is a mechanical project around the Lodgepole developed area within the Marble Fork FMU. Treatment area will be approximately 10 acres within the block on the map.
Cedar Grove	FY07	Cedar Grove pile burning	Mechanical	10	This is to burn the piles created by the FY06 mechanical project around the developed area within the Cedar Grove FMU.
North Fork	FY07	Crystal Cave pile burning	Mechanical	5	This is to burn the piles created by the FY06 mechanical project around the Crystal Cave developed area within the North Fork FMU.
Marble Fork	FY07	Lodgepole pile burning	Mechanical	10	This is to burn the piles created by the FY06 mechanical project around the Lodgepole developed area within the Marble Fork FMU.
Middle Fork	FY07	Redwood Cabin pile burning	Mechanical	6	This is to burn the piles created by the FY06 mechanical project around the Redwood Cabin area within the Middle Fork FMU.
Fiscal Year 2008					
Middle Fork	FY08	Ash Mountain/ Hospital Rock	Fire	25	These are annual maintenance burns conducted around the Ash Mountain Headquarter complex within the Middle Fork FMU.
Marble Fork	FY08	Beetle Rock	Fire	422	This restoration burn builds off the Wall Spring unit within the Marble Fork FMU.
Grant Grove	FY07	Big Stump West	Fire	118	This restoration burn builds off the Big Stump East unit within the Grant Grove FMU. There may be significant cultural resources present in this unit.
Middle Fork	FY08	Log Meadow	Fire	262	This restoration burn builds off the Upper Crescent Creek unit within the Middle Fork FMU.
East Fork	FY08	Lookout	Fire	2,528	This is a maintenance burn within the East Fork FMU.
East Fork	FY08	Mosquito	Fire	218	This is a restoration burn within the East Fork FMU.
Grant Grove	FY08	Redwood Mountain	Fire	609	This restoration burn builds off of previously burned units in the Redwood Canyon area.
Middle Fork	FY08	Upper Cliff Creek	Fire	1,148	This is a restoration near Redwood Cabin within the Middle Fork FMU. Smoke could be an issue with the town of Three Rivers.
Cedar Grove	FY08	Upper Sheep Creek	Fire	1,649	This restoration burn builds off the West Sentinel unit within the Cedar Grove FMU.
Cedar Grove	FY08	Cedar Grove	Mechanical	10	This is a mechanical project around the developed area within the Cedar Grove FMU. Treatment area will be approximately 10 acres.
Cedar Grove	FY08	Cedar Grove pile burning	Mechanical	10	This is to burn the piles created by the FY07 mechanical project around the developed area within the Cedar Grove FMU.
Marble Fork	FY08	Lodgepole pile burning	Mechanical	10	This is to burn the piles created by the FY07 mechanical project around Lodgepole.

B - NEPA and NHPA Compliance

Following National Environmental Policy Act (NEPA) guidelines and NPS policy, a companion environmental assessment evaluates the effects of proposed fire and fuels management actions on the environment. The *Environmental Assessment* and this associated plan were submitted for public review on April 16, 2003, with the comment period ending May 30, 2003.

The following text briefly describes the actions taken develop the plan and evaluate effects.

INTERNAL AND PUBLIC SCOPING

A Scoping Notice was placed in the Federal Register on February 24, 1999 and press releases regarding the planning effort were sent to media outlets in the region at the outset of the planning process. Two internal scoping meetings were held for all park and concession employees, and five additional public scoping sessions were conducted throughout California. Several presentations were made to special interest groups at their request to solicit comments. These groups included the Mineral King Cabin Owners Association and Friends of the South Fork Kings River. A community- wide survey was conducted in the greater Three Rivers area to further assess issues of concern.

INTERAGENCY SCOPING

Adjacent land managers were consulted both through the public notification process and through a separate scoping session held in Fresno in May 1999. The U.S. Fish and Wildlife Service (USFWS) was contacted at the onset of the planning process to ensure proper Section 7 consultation. A list of species to consider was received from the USFWS and used to prepare this document. Prior consultation with USFWS on the effects of prescribed burns on the threatened valley elderberry longhorn beetle is incorporated in this plan (correspondence attached at end of this chapter). The San Joaquin Valley Unified Air Pollution Control District received a separate scoping presentation and a formal written request for comment was sent to the District. No comments were received from the District during the scoping process.

CULTURAL RESOURCES AND NATIVE AMERICAN CONSULTATION

The National Park Service conducted consultation meetings in July of 1999 with a variety of Native American (American Indian) tribal groups and individuals. These meetings were held on both sides of the Sierra Nevada in areas from which Native American groups historically accessed and used lands now subsumed by Sequoia and Kings Canyon National Parks. Information was received from eight separate groups regarding their past and present uses of the parks, with a total of 33 individuals being interviewed. In very general terms, the eastside meetings included Paiute and Eastern Mono groups of the Owens Valley while the westside meetings focused on Yokuts and Western Mono (Monache) groups that traditionally occupied

portions of the Great Central Valley and western foothills and slopes of the Sierran range (Van Horn and Burge).

Overall, those groups that shared concerns or comments regarding the parks' fire program were interested in continuing to receive information and in being consulted regarding the planning and implementation of prescribed fires, in particular. A clear interest in recognizing the effects of fire on any number of natural resources was expressed, as these resources hold ongoing importance to tribal members.

INTERDISCIPLINARY PLANNING TEAM MEMBERS

Sequoia & Kings Canyon National Parks

Jeffrey Manley
Natural Resources Management Specialist

William Kaage
Fire Management Officer

Jody Lyle
Fire Information and Education Specialist

MaryBeth Keifer
Ecologist

Scott Williams
Prescribed Fire Technician
(Now employed by the USFS)

Corky Conover
Fuels Specialist

Tom Burge
Archeologist

Anthony C. Caprio
Fire Ecologist

Additional Consultants & Preparers

Dr. Nathan Stephenson
Research Scientist
USGS Biological Resources Division
Sequoia & Kings Canyon Field Station

David Allen

Sequoia District Fire Management Officer
Sequoia & Kings Canyon National Parks

Sylvia Haultain
Plant Ecologist
Sequoia & Kings Canyon National Parks

Harold Werner
Wildlife Biologist
Sequoia & Kings Canyon National Parks

Annie Esperanza
Air Quality Specialist
Sequoia & Kings Canyon National Parks

John Austin
Environmental Compliance Specialist/Resource Planner
Sequoia & Kings Canyon National Parks

Alan Schmierer
Environmental Compliance Specialist
NPS Pacific West Regional Office

Richard Smedley
Regional Fire Planner
NPS Pacific West Regional Office

Nelson Siefken
Regional Fire Archeologist
NPS Pacific West Regional Office

C - Fire Monitoring Plan and Target Conditions

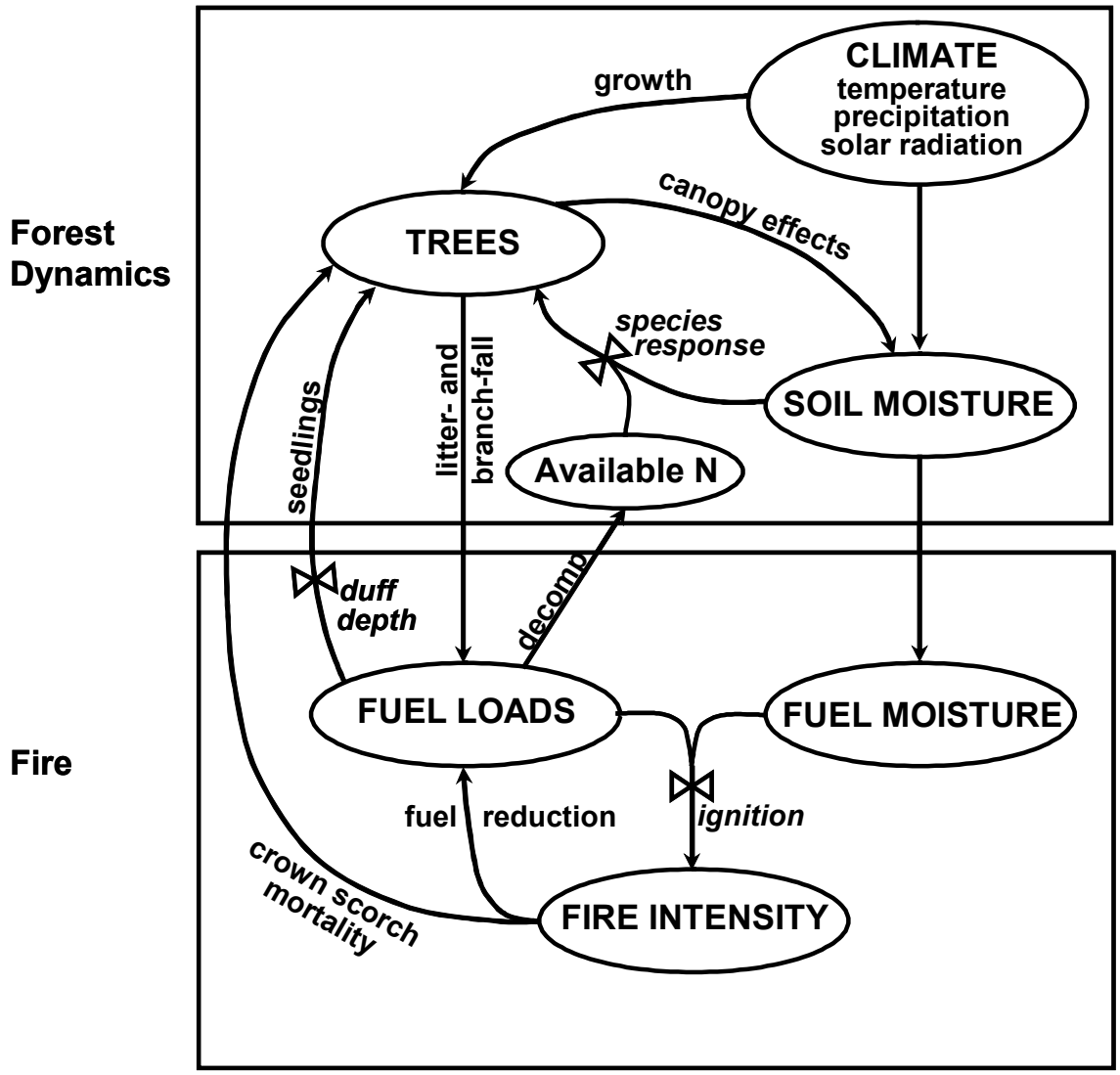
TABLE OF CONTENTS

A. INTRODUCTION

The purpose of the fire monitoring program is to provide effective evaluation of Sequoia and Kings Canyon National Parks' fire management program. The fire monitoring program is designed to determine whether fire and resource management objectives are met, as well as to document any unexpected consequences of fire management activities. The monitoring program continuously informs the staff about results of management activities so that the fire management program can adapt to changing conditions using the best available information. This plan will be reviewed annually and revised as needed.

To determine an efficient monitoring strategy to assess fire management program effectiveness, a basic understanding of the ecosystem components, processes, and linkages is needed. Based upon early fire research results, much of the current fire monitoring program for Sequoia and Kings Canyon National Parks was established prior to development of a formalized ecosystem model. Since then, a general ecosystem model was developed for the parks' Resource Management Plan (NPS 1999). Also, see the Description of NPS Unit (Chapter 8) and the Historic Role of Fire (Chapter 9) for information describing the fire- related components and processes occurring in Sequoia and Kings Canyon National Parks' ecosystems. Figure 1 illustrates the fire, fuel, and stand dynamics relationships that shape forests in the parks. Portions of the fire monitoring program focus on several of the important resource components in this model. Currently, a more detailed ecosystem model is being developed as part of the NPS Inventory and Monitoring Program. The ecosystem model is scheduled to be completed by October 2004.

Figure 1. General model showing relationships of fire, fuel, and forest dynamics in the Sierra Nevada (Miller and Urban 1999).



The parks' formal fire monitoring program began in 1982. The program initially focused on monitoring weather and fire behavior, vegetation, and dead and down surface fuels in giant sequoia groves. Over time, the monitoring program expanded to other vegetation communities as the prescribed fire program progressed. In recent years, it has broadened to include wildlife, water, and fire regime components as program information needs have changed and new management objectives were developed.

While the monitoring program is designed to document changes that occur in areas where fire management activities take place, many factors (e.g. climate, pollution, pathogens) may play a role in ecosystem changes. If the monitoring program detects an unexpected change, a more detailed research project designed specifically to test a hypothesis may be needed to determine the cause of the change. A Research Plan describes past, current, and potential research studies that provide additional information to the fire management program (see Appendix D).

Wherever possible, new information gained will be used to inform and improve the fire monitoring program.

Following a summary of fire- related target conditions and management objectives, this monitoring plan is organized into several sections, each of which addresses a current component of the parks' fire monitoring program or identifies areas for future monitoring efforts. The individual sections describe the identified information need, the management targets/objectives (if developed), the monitoring objectives, and the monitoring design for the following resource components:

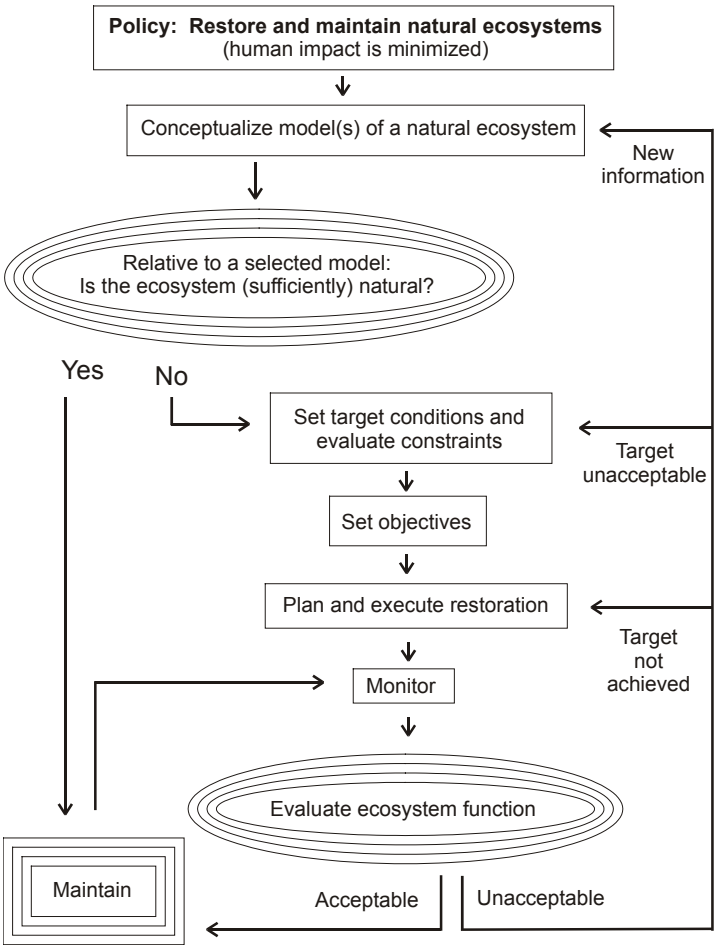
- Environmental and Fire Conditions
- Vegetation and Fuels
- Additional Fuels Information for Modeling
- Wildlife
- Water
- Fire Regime
- Cultural Resources

Note that Air Quality monitoring is covered separately in Appendix J. Following the individual resource components sections, a brief section on monitoring program integration presents the relationships between the current components, as well as the need and plans for improved future integration.

B. TARGET CONDITIONS & SPECIFIC MANAGEMENT OBJECTIVES

An adaptive feedback process is used to guide and evaluate the fire and fuels management program (Figure 2). This process begins with policy direction and incorporates the most current information to make knowledge- based management decisions about how best to restore and maintain fire- related natural resource components and processes. These decisions are continuously evaluated based on monitoring results and new research and information is integrated to help guide the management program.

Figure 2 – Model of adaptive feedback process (Keeley and Stephenson 2000).



Fire management program goals and objectives are described in Chapter 2. One program objective is to understand the effects of fire management actions by monitoring and evaluating the effects of fire and fuels management activities on park natural and cultural resources with particular attention to vegetation, water, wildlife, air, and cultural resources. To accomplish this task, specific, measurable benchmarks may be needed as a point of reference to determine if the resource conditions resulting from fire management actions are meeting park goals for restoring and maintaining natural conditions. To answer the question, "What would the resource look like if we achieve our goals?", target conditions are needed to describe resource goals more specifically and to serve as a standard by which to measure fire management program success.

Information used to develop the target conditions includes research data where available, historic photos and written documents, and expert opinion. Target conditions must be periodically evaluated to determine whether they are still realistic and wanted in light of a changing environment. For example, target conditions may be based on our knowledge of past long- term climate conditions, however, future climate changes may preclude achieving these targets. The target conditions will be further refined as new research provides information that increases our knowledge of past, current, and future conditions.

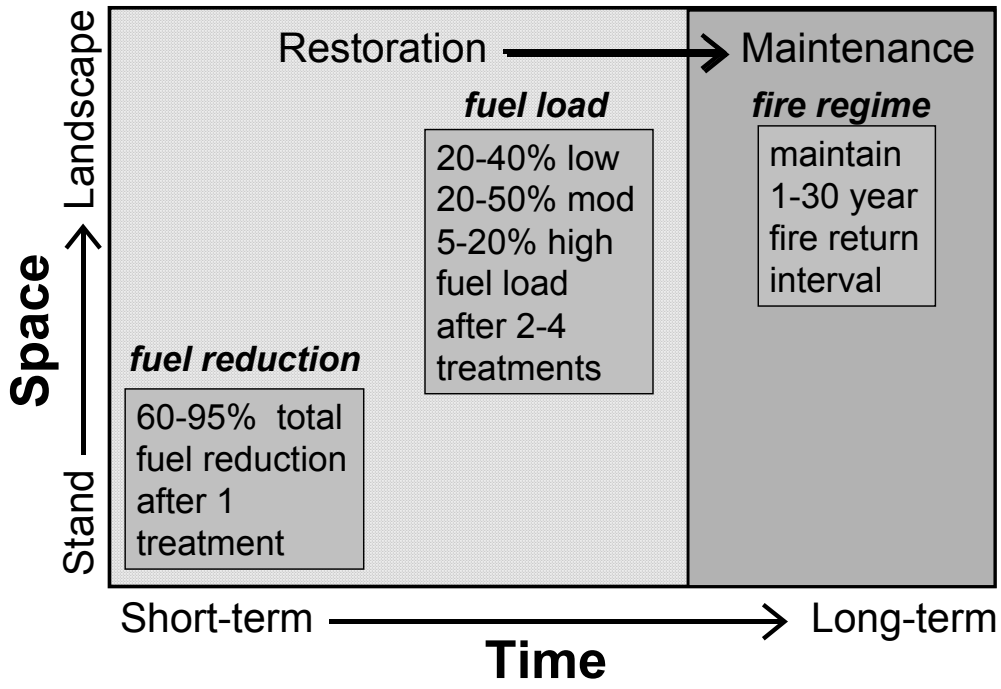
To describe explicitly how to arrive at the target conditions, specific management objectives are developed by adding a method and timeframe to the target conditions. For example, if the target condition is a stand density of 20- 250 trees/ha, then the management objective would be to use prescribed fire to reduce stand density to 20- 250 trees/ha by 2 years following treatment. Target conditions and specific management objectives for each resource component, where developed, are described in the corresponding individual sections of this monitoring plan.

In areas of the parks currently in the restoration phase of the program, structural targets and objectives are used to assess program success. Once these structural conditions are restored, then the area moves into the maintenance phase of the program and process targets are used to evaluate the program goal achievement. Figure 3 illustrates the changing nature of targets/objectives over time from the restoration phase to the maintenance phase using an example of fuel load objectives.

Like target conditions, management objectives must be evaluated on a regular basis. As the monitoring results become available, they are used to determine if management objectives are achieved and to determine if management activities need to be adjusted. Also at this time, an assessment of whether the management objectives are still desired is warranted in light of ongoing monitoring results and any new information made available.

Some of the monitoring program components that follow have target conditions and specific management objectives defined, while others have only general goals outlined. Part of the next phase of the monitoring program includes identifying additional targets and management objectives, then developing associated monitoring objectives, and refining or adding protocols if necessary. In this way, we can be sure that the monitoring program will adequately assess the success of the fire management program. Any changes or additions will be included in future revisions of this fire monitoring plan.

Figure 3. Objectives change as the fire management program progresses over time and expands in spatial scale.



C. ENVIRONMENTAL & FIRE CONDITIONS

The first two monitoring levels described in the Fire Monitoring Handbook (FMH; National Park Service 2001), environmental monitoring and fire observations, provide information to guide fire management strategies for wildland and prescribed fires.

Monitoring Goal: Environmental monitoring and fire observations provide the basic background information needed for decision- making before, during, and after fire events.

Monitoring Objectives

1. Collect information on environmental conditions (weather [current and forecasted], fuel model) and fire conditions (name, location, slope, aspect, spread, intensity, smoke transport and dispersal) for all wildland and prescribed fires.

2. Use the information collected in a timely manner to adapt to changing conditions and successfully manage each fire.

Field Measurements

The following information will be collected for all wildland and prescribed fires: location, cause, current size, air temperature, relative humidity, wind speed, wind direction, percent slope, aspect, National Fire Danger Rating System (NFDRS) fuel model appropriate index (energy

release component [ERC] or burning index [BI]), representative Fire Behavior Prediction System (FBPS) fuel model, rate of spread, direction of spread, flame length (or relative intensity), perimeter and area growth, and smoke transport and dispersal.

In addition to the data listed above, the following information will be collected for all prescribed fires: live fuel moisture (if applicable), dead fuel moisture (1 hour, 10 hour, 100 hour, 1000 hour, litter, duff) as indicated in the site specific burn plan prescriptions, road or sensitive site visibility, smoke column mixing height, smoke transport and dispersal direction. Smoke particulate data may be collected at smoke sensitive locations as indicated in the site- specific burn plan.

Timing of Monitoring

All prescribed fires will have the environmental conditions monitored at least two weeks in advance of the planned ignition date. On- site weather and fire condition monitoring will occur throughout all active ignition phases of each fire on a schedule determined by the burn boss with consultation from the lead monitor assigned to the fire.

Weather conditions for all wildland fires will be monitored regularly from the time of discovery/ignition and throughout the duration of the fire. The monitoring frequency will be specified in the Wildland Fire Implementation Plan (WFIP).

Monitoring Site Location

On- site environmental conditions for all prescribed fires will be monitored at a representative location within the burn area, as determined by the burn boss with consultation from the lead monitor assigned to the burn. The weather conditions will be monitored using an existing representative fire weather station or if there is no representative station (as determined by the burn boss), a portable station will be set up on site.

Weather conditions for most wildland fires will be monitored using an existing representative fire weather station. On- site environmental and fire conditions for all wildland fires will be monitored as indicated in the WFIP.

Data Analysis

Environmental monitoring and fire observations provide the basic background information needed for decision- making. For prescribed fires, the assigned monitor will relay the data to the burn boss and fire management staff on a regular basis (prior to the ignition of a prescribed fire, and at a predetermined interval during the active ignition phase to facilitate proper management). The burn boss will use the information to verify that the fire is within the prescribed conditions and to adjust the timing, quantity and spacing of new ignitions.

Environmental data from wildland fires will be transmitted to the fire use manager or incident commander as soon as possible to facilitate the proper and timely management of the fire. On longer duration fires, the data will be used to create weather, wind and fuel moisture input files needed for fire spread simulation. The outputs from the fire spread projections will be used to estimate the fire's arrival to areas of concern and allow for enough time to plan for the

protection or mitigation efforts needed. The parks' fire staff may also use the data to adjust and run risk assessment models.

Data Sheet Examples

Data sheets used to collect information include a weather observation form, fire behavior observation form, smoke observation form, fuel moisture summary form, monitoring report outline, and wildland fire observation summary form (see Attachment 1).

Information Management

All original data sheets and summary reports will be kept in the permanent fire folder located in fire dispatch. Electronic file copies will also be placed in the fire folder when available. The permanent fire folder will be kept in accordance with Appendix Q (Wildland Fire and Fuels Management Reporting Requirements) of the Fire and Fuels Management Plan.

Quality Control

Monitoring personnel will receive appropriate training each season under the direction of the fire monitoring crew supervisor. This training will cover the proper protocols for collection and transmission of environmental and fire conditions data. New monitors will receive a minimum of two training assignments before they can function as a lead monitor. The appropriate supervisor will review all summary reports prior to placement in the fire folder.

Responsible Party

The person in charge of the fire (burn boss, incident commander or fire use manager) is responsible for ensuring that the environmental data is collected, transmitted, acted upon, and filed according to established protocols.

Funding

All fire expenditures (personnel, aircraft, equipment and supplies) that are not covered by existing base accounts will be charged to the appropriate fire account. All expenditures will be tracked and reported according to the standards established in the Department of the Interior Individual Fire Occurrence Form (DOI- 1202). All fires will have an appropriate fire management accounting code (suppression, prescribed or fire use).

Management Implications of Monitoring Results

Because environmental and fire condition monitoring is essential background information needed for effective decision making, the success or failure of a fire could very well depend on the proper and timely collection and transmission of this data. When properly executed, feedback from the monitoring of environmental and fire conditions will directly affect how the fire is managed. If a prescribed fire has exceeded the prescribed conditions, the field monitor will notify the burn boss who will limit any new ignitions and evaluate the situation. For wildland fires, the parks' fire managers will use the information to prioritize fires for assignment of critical resources. For example, a wildland fire that is being suppressed might receive more

resources quickly if information relayed indicates that the fire is about to spread into a different fuel type that will result in a higher resistance to control. For wildland fire use projects, the environmental and fire conditions information will be used to help determine the level of monitoring needed for each fire.

D. VEGETATION AND FUELS

Monitoring levels 3 and 4 of the Fire Monitoring Handbook (FMH; National Park Service 2001), describe short- and long- term monitoring of the effects of fire on fuels and vegetation to guide prescribed fire management strategies. While the standard vegetation and fuels monitoring component applies primarily to prescribed fire, monitoring wildland fire and mechanical fuel removal activities and unburned areas has occasionally occurred when a particular need or opportunity arose.

Monitoring Goal: Vegetation and fuels monitoring provides information needed to determine whether management objectives are met and to detect any unexpected consequences of prescribed burning or other treatments.

Target Conditions

Fire- related vegetation and fuels target conditions for each vegetation type within the parks were developed by a team of scientists and park managers using the best available information about conditions present in the parks during the 1,000 years prior to Euroamerican settlement. These target conditions are divided into two types of conditions, structural targets for the restoration phase of the program and process targets for the maintenance phase of the program (Table 1). Targets for structure describe attributes of the dominant vegetation and were developed for areas being initially treated with prescribed fire to restore conditions significantly altered by fire exclusion. Structural target conditions were not developed for vegetation types where the structure has not been greatly altered by fire exclusion (e.g. historic fire return intervals are as long or longer than the period of fire exclusion). Targets for process describe attributes of the historic fire regime and are applied to areas that have not been greatly altered by fire exclusion or areas where conditions have been restored with prescribed fire.

Table 1 – Target conditions by vegetation type. Restoration phase targets (structure) are in unshaded cells and maintenance phase targets (process) are indicated by shaded cells.

Vegetation Type	Fuel Reduction [*restoration*]	Stand Density by diameter class & spp. comp. [*restoration*]	Fuel Load Distribution (% of landscape) [*maintenance*]	Gap/Patch Size Distribution (% of landscape) [*maintenance*]
Ponderosa pine- mixed conifer	60-95% total fuel reduction	50-250 trees/ha <80 cm 10-75 trees/ha 80 cm (50-80% pine, 5-20% fir, 10-20% cedar, 1-10% oak)	20-40% 5-30 tons/acre 20-50% 30-60 tons/ac 5-20% >60 tons/acre	75-95% 0.1-1 ha 5-25% 1-10 ha <1% 10-100 ha (% is percent of landscape)
White fir- mixed conifer	60-95% total fuel reduction	50-250 trees/ha <80 cm 10-75 trees/ha ≥80 cm (40-80% fir, 15-40% pine, 0-20% cedar)	20-40% 5-30 tons/acre 20-50% 30-60 tons/ac 5-20% >60 tons/acre	75-95% 0.1-1 ha 5-25% 1-10 ha <1% 10-100 ha
Giant sequoia- mixed conifer *	60-95% total fuel reduction	50-250 trees/ha <80 cm 10-75 trees/ha ≥80 cm (40-80% fir, 10-40% sequoia, 5-20% pine)	20-40% 5-30 tons/acre 20-50% 30-60 tons/ac 5-20% >60 tons/acre	75-95% 0.1-1 ha 5-25% 1-10 ha <1% 10-100 ha
Subalpine	NA	NA	NA	NA (woodland type)
Xeric conifer / montane chaparral	NA	10-150 trees/ha <80 cm 5-50 trees/ha ≥80 cm (60-80% pine, 20-40% fir)	1-30% 5-10 tons/acre 25-75% 10-30 tons/ac 1-10% >30 tons/acre	NA (woodland/ savannah type)
Red fir	60-95% total fuel reduction	50-500 trees/ha <80 cm 10-75 trees/ha ≥80 cm (70-100% fir, 0-30% pine)	1-25% 5-30 tons/acre 30-70% 30-60 tons/ac 5-20% >60 tons/acre	70-95% 0.1-1 ha 5-30% 1-10 ha <1% 10-100 ha (0-1% <1 yr gaps)
Lodgepole pine	NA	NA	not yet developed	not yet developed
Mid-elevation hardwood	NA	20-200 trees/ha <80 cm 10-50 trees/ha ≥80 cm (50-80% oak, 10-40% pine, 1-10% cedar)	40-60% 5-20 tons/acre 10-40% 20-50 tons/ac 0-15% >50 tons/acre	NA (woodland type)
Oak woodland	NA	20-150 trees/ha 10-50 cm 5-50 trees/ha ≥50 cm (80-100% oak, 0-20% other)	90-95% 0-1 ton/acre 5-10% 1-4 tons/acre	NA (woodland type)
Foothill chaparral	NA	25% 0-20 yr old stands 50% 20-50 yr old stands 25% >50 yr old stands (species composition varies depending on FRI)	NA	0.1 – 2000 ha (same as fire size)

* An additional goal to perpetuate giant sequoias does not currently have specific, quantitative objectives defined, but the monitoring program tracks mature tree mortality and regeneration and recruitment of giant sequoias. In addition to the standard monitoring protocols, projects to track giant sequoia post-burn effects and to monitor sequoia seedling survival in reburns are described in the Additional Projects section below.

Monitoring Objectives

Specific fire- related management objectives that describe how to reach the target conditions were developed (Table 2). Explicit monitoring objectives were then established so that results from the vegetation and fuels monitoring program will be able to provide sufficient information to determine whether the corresponding management objectives have been achieved. The monitoring objectives specify what is to be measured (variables), what time interval to measure, and the level of certainty desired in the results. This information is then used to calculate the minimum sample size necessary to obtain the level of certainty needed in the results.

Table 2 – Vegetation and fuels management objectives and monitoring objectives. Restoration (structure) objectives are in unshaded cells and maintenance (process) objectives are in shaded cells.

Variable and Vegetation Type	**Management Objective (restatement of applicable target conditions from Table 1)**	**Monitoring Objective**
Fuel Load *[restoration]* **All Forest Types**	Reduce total dead and down fuel load by 60-95% immediately following initial treatment with prescribed fire.	Measure total fuel load with a sample size sufficient to have an 80% probability of detecting at least a 40% reduction in mean total fuel load immediately postburn. A 20% chance that a change will be detected when a real change does not occur is acceptable.
Fuel Load [*maintenance*] **Mixed- Conifer Forest**	Use fire to maintain fuel load mosaic across the landscape as follows: 20-40% 5-30 tons/acre 20-50% 30-60 tons/acre 5-20% >60 tons/acre *Note: % is percent of landscape for all Mixed-Conifer Forest types.*	Measure total fuel load with a sample size sufficient to have an 80% probability of being within 25% of the true mean total fuel load for all time intervals of interest.
Fuel Load *[maintenance]* **Red Fir Forest**	Use fire to maintain fuel load mosaic across the landscape as follows: 1-25% 5-30 tons/acre 30-70% 30-60 tons/acre 5-20% >60 tons/acre *Note: % is percent of landscape in Red Fir forest.*	
Stand Structure *[restoration]* **Mixed-Conifer Forest**	Use prescribed fire to restore mixed-conifer forest mean stand density to: 50-250 trees/ha for trees <80 cm DBH 10-75 trees/ha for trees ≥80 cm DBH by 5-years following initial treatment with prescribed fire. Species composition by forest type: Ponderosa pine – 50-80% pine, 5-20% fir, 10-20% cedar, 1-10% oak; White fir – 40-80% fir, 15-40% pine, 0-20% cedar; Giant sequoia – 40-80% fir, 10-40% sequoia, 5-20% pine.	Measure total tree density with a sample size sufficient to have an 80% probability that the 5-year postburn mean total density of trees <80 cm in diameter at breast height (DBH) and trees ≥80 cm DBH is within 25% of the true population means.
Stand Structure [*restoration*] **Red Fir Forest**	Use prescribed fire to restore red fir forest mean stand density to: 50-500 trees/ha for trees <80 cm DBH 10-75 trees/ha for trees ≥80 cm DBH by 5-years following initial treatment with prescribed fire. Species composition: 70-100% fir, 0-30% pine.	

Variable and Vegetation Type	**Management Objective (restatement of applicable target conditions from Table 1)**	**Monitoring Objective**
Landscape Pattern [*maintenance*] **Mixed-Conifer Forest Types**	Use fire to maintain the distribution of gaps/patches across the landscape as follows: 75-95% 0.1-1 ha gaps/patches 5-25% 1-10 ha gaps/patches <1% 10-100 ha gaps/patches *Note: % is percent of landscape comprised of gaps of each size class.*	*Note: Monitoring methods for assessing landscape pattern objectives have yet to be developed. These variables will likely be measured using some type of remote sensing.*
Landscape Pattern [*maintenance*] **Red Fir Forest**	Use fire to maintain the distribution of gaps/patches across the landscape as follows: 70-95% 0.1-1 ha gaps/patches 5-30% 1-10 ha gaps/patches <1% 10-100 ha gaps/patches	
Stand Structure *[*maintenance*]* **Brush Types**	Use fire to maintain a shrub stand age structure mosaic across the landscape as follows: 20-30% 0-20 year old stands 40-60% 20-50 year old stands 20-30% >50 year old stands. *Note: species composition varies depending on fire return interval.*	Measure live shrub cover with a sample size sufficient to have an 80% probability of being within 25% of the true pre-burn mean live shrub percent cover. (*Note: This objective may be better monitored by using the time since last fire GIS layer; see Fire Regime section H; species composition may still require plot-level monitoring*).

Target conditions developed for stand structure in brush types focus on maintenance of stand age classes. Since no specific objectives for restoring shrub cover currently exist, the monitoring objective focuses on getting good estimates of the pre- burn shrub cover conditions until further target conditions are developed.

In vegetation types where fire exclusion has not greatly altered the structure, target conditions were not developed, therefore, specific management objectives and monitoring objectives have also not been developed for these vegetation types. In addition, monitoring methods for assessing landscape pattern objectives have yet to be developed. Variables such as gap size and distribution across the landscape will likely be measured using some type of remote sensing (e.g. Landsat TM, aerial photography, LIDAR, etc.). Monitoring for other objectives related to maintaining the natural process of fire are discussed in the Fire Regime section (section H) of this plan.

Sampling Design

The sampling design is intended to allow the monitoring objectives to be achieved as efficiently as possible. The vegetation and fuels monitoring program generally follows the NPS Fire Monitoring Handbook (FMH; National Park Service 2001) protocols, with some deviations because the parks' program was initiated prior to the NPS program. Currently, eight monitoring types (combination of vegetation type, fuel model, and burn prescription) exist, of which seven

describe the vegetation and fuels located in areas where prescribed burning occurs. One monitoring type is associated with an area burned in a WFU project. See Attachment 2 for current monitoring type descriptions.

For each monitoring type, the minimum sample size was calculated to determine the number of plots needed to achieve the monitoring objectives as efficiently as possible. This information, along with the current plots installed and new plots planned, comprises the plot installation plan (Table 3).

Table 3 – Vegetation and fuels monitoring plot installation plan.

Monitoring Type Name	Minimum Sample Size*		Current # of Plots	# of New Plots Planned	Total # of Plots
	Total Fuel Reduc.	Density (<80 cm, ≥80cm) or % Cover			
Ponderosa pine-dominated forest	5	1, #	4	6	10
Low elevation-mixed conifer forest	4	7, 29	5	5	10
White fir-mixed conifer forest	12	3, 7	11	2	13
Giant sequoia-mixed conifer forest	5	10, 9	29	1	30
Red fir forest	#	# , #	6	4	10
Chamise chaparral	-	1	3	0	3
Mixed chaparral	-	2	6	4	10
Montane chaparral‡	‡	‡	4	0	4
TOTAL			**68**	**22**	**90**

Key:

* Minimum sample size was calculated for objective variables. In all forest types, calculations were performed for immediate-postburn total fuel reduction (precision, R=25; confidence level, α= 80%, power=80%, minimum detectable change=40%) and 5-year postburn total tree density for trees <80 cm DBH and ≥80 cm DBH (precision, R=25; confidence level, α=80%). In all brush types, calculations were performed for pre-burn live total shrub cover (precision R=25, confidence level, α=80%).

\# A minimum sample size for this category is not available because it is either not applicable or there are not enough plots or data to calculate.

‡ Monitoring type associated only with WFU project; no minimum sample size calculated.

Current Plans by Monitoring Type

Ponderosa pine- dominated forest – Although we only need to install one more plot to reach the minimum sample size, this type is of particular interest regionally and nationally, therefore, we

would like to increase the number of plots to ten, if possible. Due to the limited distribution of this type in the park (restricted primarily to Cedar Grove) and the extent of the type already burned, we may have difficulty reaching ten plots. In addition, prescribed fire projects in Cedar Grove have been on hold since 1998 to investigate the role of fire and other factors in a locally severe cheatgrass (Bromus tectorum) invasion.

Low elevation- mixed conifer forest – We are scheduled to install five more plots in this type in order to achieve an initial ten plots with which to calculate the minimum sample size. Based on calculations using the five plots that have reached the 5- year post- burn stage, the number of plots needed to achieve the monitoring objective for smaller diameter tree density is excessive. This number of plots may decrease after the additional plots are installed and the sample size is recalculated.

White fir- mixed conifer forest – We have nearly reached the minimum sample size for this type (12 plots), and we are scheduled to install two more plots in the East Fork Kaweah Fire Management Unit (FMU) in order to have vegetation types better represented within this watershed (three plots), where the program has focused on larger landscape- scale prescribed fire.

Giant sequoia- mixed conifer forest – One more plot is scheduled for installation in the East Fork Kaweah FMU to achieve better representation within the watershed (three plots). Otherwise, we have well exceeded the minimum sample size needed for the monitoring objectives in this type.

Red fir forest – We are planning to install at least four more plots, for a total of ten initial plots. Although six plots have been installed, only two plots have burned and therefore we will calculate minimum sample size when a few more plots have burned.

Chamise chaparral – We have achieved the minimum sample size for this type and do not plan on installing any more plots.

Mixed chaparral – Although we have exceeded the minimum sample size needed in this type, we plan to install four more plots so that the plots are somewhat more geographically distributed.

Montane chaparral – Prescribed burning has been limited in this monitoring type in the past. The current plots in this monitoring type were opportunistically installed within a WFU project and were all burned in one event. If prescribed burning is carried out in this vegetation type according to the 5- year burn plan (1800 acres), more monitoring plots may be installed.

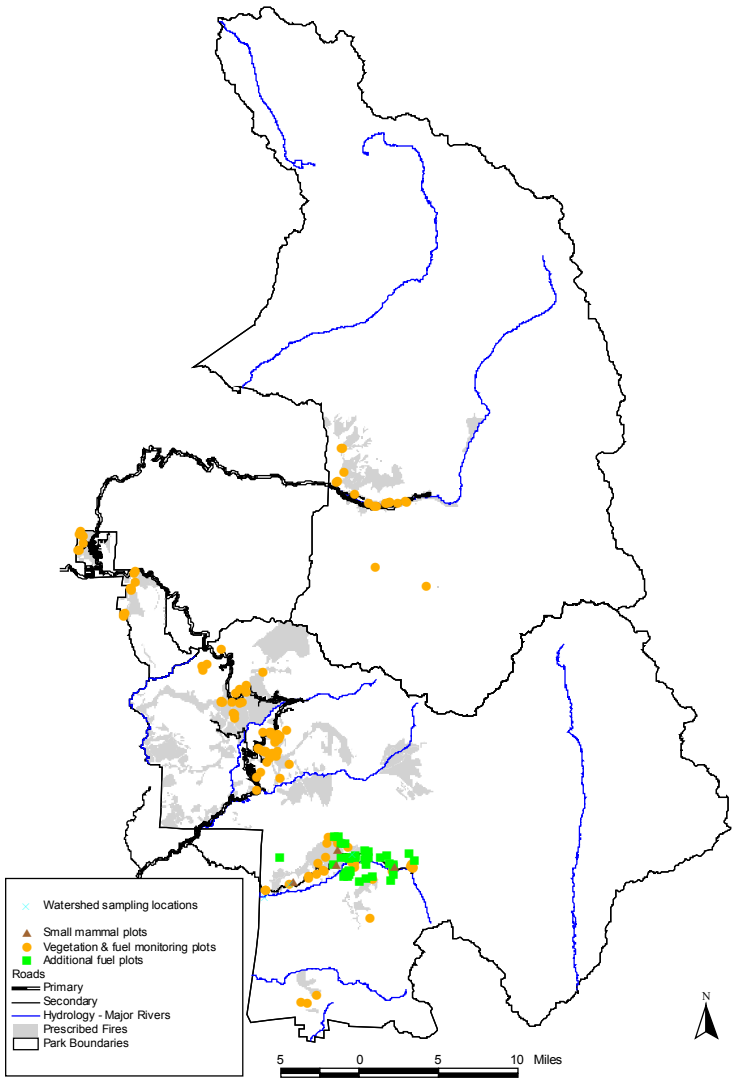
New Monitoring Types – Several new monitoring types may be needed based on the current 5- year burn plan. These monitoring types include foothill hardwoods and grassland, mid- elevation hardwood forest, and xeric conifer forest. In the past, prescribed burning in these types has been limited, but if the amount of prescribed burning increases according to the current 5- year plan (1600 acres of foothill hardwoods and grassland, 850 acres of mid- elevation hardwood forest, and 2300 acres of xeric conifer forest), we will need to address these types. We have also discussed monitoring in our Ash Mountain development hazard fuel reduction burns primarily to monitor native vs. non- native dynamics. We have not yet had the time to carry out this monitoring as it has not been a high priority, but it may be included in future monitoring

efforts. Pilot sampling will occur prior to monitoring in any new vegetation types to be sure that the future monitoring efforts are as efficient and effective as possible.

Plot Distribution

Many of the existing permanent plots were installed prior to the establishment of the FMH program within the region. Little formal documentation exists of the method used for selecting burn units in which these monitoring plots were located prior to 1992. From the information we have, these early plots were randomly located within areas scheduled for burning within the near future and were stratified by monitoring type. Plots installed between 1992 and 1996 were distributed randomly in areas scheduled for burning within the subsequent five years, stratified by monitoring type. Plots installed after 1996 were distributed using a "restricted random" design to avoid spatial clumping of plots. Current plot locations and associated burn unit boundaries, are shown in Figure 4.

Figure 4 – Map of current monitoring plot locations. Burn units shown in shaded areas.



Plots organized by monitoring type and burn unit can be found in Table 4. In the monitoring type heading, the number of plots currently installed, as well as the number of prescribed burn units (# fires) associated with these plots, is included to show the treatment replicates within each monitoring type.

Table 4 – Plot distribution by burn unit and monitoring type.

Burn Unit Year Burned	Monitoring Type							
	FABCO **11 plots 7 fires**	FCADE **5 plots 3 fires**	FPIPO **4 plots 2 fires**	FSEGI **30 plots 18 fires**	FABMA **6 plots 4 fires**	BADFA **3 plots 1 fire**	BARME **6 plots 2 fires**	BARPA **4 plots 1 fire**
Hercules 1982,*1999	-	-	-	*1,2,3,4	-	-	-	-
Fire Class 1984,*1996	13,14	-	-	11*,12*	-	-	-	-
Garfield 1985	-	-	-	22	-	-	-	-
Muir PNF 1986	34	-	-	30	-	-	-	
Upper Garfield 1986	-	-	-	32	-	-	-	-
Keyhole 1987,*1998	-	-	-	15,24*	-	-	-	-
Tharps 1987,*1998	-	-	-	42*,43	-	-	-	-
Halstead 1987	44,45	-	-	-	-	-	-	-
Buckeye WF 1988	26	-	-	-	-	-	-	-
Huckleberry 1989 ,*1997	53*	-	-	52*	-	-	-	-
Crystal 1989	-	60	-	-	-	-	-	-
Tharps 1990	-	-	-	68	-	-	-	-
Highway 1990	-	-	-	79,80	-	-	-	-
Suwanee 1990	-	-	-	69	-	-	-	-
Grant West 1990	-	-	-	74	-	-	-	-
President SMA 1991	-	-	-	81	-	-	-	-
Tharps 1991	-	-	-	82	-	-	-	-
Deer Creek PNF 1991	-	-	-	87,88	-	-	-	-
Grant West 1992	-	63	-	72,73,75	-	-	-	-
Suwanee 1992	76,77, 78	-	-	70,71	-	-	-	-
Picnic Estates 1993,*1999	-	-	89*	-	-	-	-	-
Hole-in-the-Wall 1993	-	-	90,91 92	-	-	-	-	-
Empire PNF 1994	-	-	-	-	-	-	-	B2,3,4,5
Swale 1995	-	62,65	-	-	-	-	-	-
MK - Atwell 1995	-	94	-	93,95	96,97	-	-	-
MK - Lookout 1997	-	-	-	-	-	B12, 13,14	-	-

Burn Unit Year Burned	Monitoring Type							
	FABCO **11 plots 7 fires**	FCADE **5 plots 3 fires**	FPIPO **4 plots 2 fires**	FSEGI **30 plots 18 fires**	FABMA **6 plots 4 fires**	BADFA **3 plots 1 fire**	BARME **6 plots 2 fires**	BARPA **4 plots 1 fire**
MK - Redwood 1997	-	-	-	-	-	-	B10,11	-
MK - Tar Gap 1999	-	-	-	-	101	-	-	-
MK - Redwood	-	-	-	-	-	-	B7,8,9, 15	-
MK - Tar Gap	-	-	-	-	100,102	-	-	-
MK - Upper Deadwood	105	-	-	-	-	-	-	-
Wuksachi	-	-	-	-	103	-	-	-

Field Measurements

The field measurement protocols follow those found in the NPS Fire Monitoring Handbook (National Park Service 2001) with the following exceptions:

1. The parks' tree size definition is as follows:

   Overstory trees are those trees reaching breast height and greater.

   Seedling trees are those trees less than breast height.

   The parks do not distinguish pole- size trees as defined in the FMH.

   These categories have been maintained because: 1) they are standard parkwide definitions used in previous and ongoing research, and 2) they were in place prior to the FMH guidelines and long- term consistency is extremely important. The tree diameter breakdown can be changed relatively easily by data manipulation, if necessary, so that the protocol deviation only affects trees in the seedling size class.

2. During sampling of brush monitoring types, measuring brush density of some of the species proved very difficult. Even for some of the species that are not clonal, distinguishing among individuals can be difficult as the stems grow very close together, often in clumps; determining if the stems are attached or separate can sometimes only be accomplished by excavation. We found that counting individual plants is not repeatable among crew members, leading us to be concerned about the reliability of density measurements for these brush species. We are unable to get repeatable data and are concerned that to do so correctly would require highly disruptive and time- consuming methods (i.e. digging). In addition, our current efforts to develop management objectives for chaparral are focused on brush cover and not density, therefore, we will not collect brush density measurements in these areas unless our management objectives change.

3. The original method used for measuring herbaceous vegetation was a line- intercept method when the program began in 1982, therefore, all plots installed prior to 1989 used this method. All plots installed after 1989 use the current point- line intercept standard method outlined in the FMH (National Park Service 2001). Beginning in 1992, conversion of pre- 1989 plots to the new method began by performing both measurement techniques until the plots were burned again, and thereafter switching to the point- line intercept method. In this way, herbaceous vegetation sampling on all plots will eventually use the same method (point- line intercept).

Timing of Monitoring

All plots currently follow the monitoring frequency recommended in the FMH: pre- burn, immediately postburn, 1- year, 2- years, 5- years, and 10- years postburn or until burned again (National Park Service 2001). Once a monitoring plot is burned again, the same frequency of monitoring is repeated. Deviations to this frequency occurred prior to the existence of the NPS monitoring program when plots installed prior to 1989 were not usually re- measured 2- years postburn. The master plot list (fmhplots.dbf) in the FMH database, lists these individual plot monitoring frequency deviations in the comments field. In addition, occasionally a plot re-measurement was not possible due to late season weather or limited monitoring resources. Again, in these cases, the frequency deviations are listed in the comments field of the FMH database master plot list.

Monitoring Plot Relocation

All monitoring plots are permanently marked with painted rolled- steel bars with labeled tags according to the FMH recommended standards (National Park Service 2001). All plots have written descriptions of their location, hand drawn maps, and are geo- referenced using a GPS unit (a few plots have not yet been geo- referenced but will be on their next visit). The plots will be relocated using a combination of the above references. Copies of all plot location description sheets (FMH- 5) are stored with the Regional Fire Effects Monitoring Program Manager in the Pacific West Regional office in Oakland. All updated vegetation and fuels plot locations (UTM coordinates) are stored on the parks' local area network (LAN; j:\data\study_sites\permanent\fire_eff\loc_fmh.dbf .

Data Analysis

Data from the standard vegetation and fuels monitoring program, along with the other projects that supplement the standard program (see Additional Projects section below), provide the following results (bold indicates results related to management objectives):

- dead and down fuel reduction and accumulation
- changes in overstory tree density and species composition by diameter class and condition
- changes in seedling tree density and species composition by height class
- changes in snag density and snag formation/breakdown rates
- changes in shrub density (or cover) and species composition
- changes in cover and species composition of herbaceous vegetation
- changes in ground cover
- changes in species richness

• detection of non- native species
• burn severity
• immediate- postburn effects on trees (maximum bark char and crown scorch heights, percent crown scorch)
• mortality of large pines with and without basal fuel removal
• mortality and survival of postfire- regenerated giant sequoia seedlings following subsequent prescribed fire treatment.

Results for all objective variables are analyzed on an annual basis and presented in the program annual report. Currently, the analyses that are directly tied to specific management objectives in forest monitoring types are:
1. mean total fuel reduction immediately following prescribed fire, and
2. mean stand density (by diameter class and species) five years following prescribed fire.

For fuel reduction objectives, we calculate the 80% confidence interval of the mean percent total fuel reduction (average change of individual plot fuel reduction) to determine whether postburn fuel reduction estimates fall with the range set in the objectives. For stand density objectives, we use the 80% confidence interval of the 5- year postburn stand density to measure whether stand density estimates falls within the targeted range for both tree diameter classes (<80 cm and • 80 cm). In addition, we examine the species composition (by density) to determine whether it falls within the targeted ranges. While the time period for stand density objectives is five years, we analyze stand density one and two years following prescribed fire in order to evaluate progress towards achieving the targets as the majority of tree mortality occurs during that time period.

Methods to measure landscape pattern are currently under development and when implemented, we will perform analyses to appropriately assess these objectives. Also, as other new objectives are developed, additional corresponding analyses will be warranted.

Additional analyses performed on an annual basis include fuel reduction and accumulation over time by fuel component (litter, duff, and wood) and stand density changes 10 years following prescribed fire. These analyses are useful in helping to determine when areas will be scheduled for subsequent treatment with prescribed fire (e.g. How long after initial treatment before fuel loads approach pre- burn levels?). The long- term analyses are also useful in assessing whether giant sequoia recruitment is occurring in areas burned, important for the parks' goal of perpetuating giant sequoias. Changes in shrub cover by species composition are also analyzed in brush monitoring types while specific objectives for the brush types are still in development.

Due to time limitations, analyses of variables not related to objectives have been consistently performed. Our intention is to analyze additional variables more consistently, with a goal of performing the non- objective- related analyses at least once every three years. Other analyses that should be performed include: shrub and herbaceous cover and species composition changes, species richness, burn severity and ground cover. Analysis of the additional project results (see Additional Project section below) should also occur on a regular basis so that the information can be used for future planning purposes. Each year, the progress made on each project, including any new analyses, will be summarized in a report.

Data Sheet Examples

Data sheets used for monitoring are those found in the FMH, Appendix A (National Park Service 2001). Local modifications of these standardized data sheets are stored in the forms file drawer in the fire effects monitoring program office.

Information Management

The most current copy of the digital database is located on the parks' local area network (j:\data\plants\fire_effects\vegetation_fuels_fmh\primary_data\sekidbf.zip). All raw data sheets (stored in folders by plot) and photographic slide files are located at the fire effects monitoring program office at the parks' Ash Mountain headquarters. The updated database resides on the fire effects crew computer located in the central room of the office (c:\fmh) and are backed up on the Ecologist's computer (c:\fmh) and on zip disks stored in the Division of Natural Resources office mailbox and the Ecologist's residence. Copies of the database files, plot location descriptions and maps, and an annual copy of the digital database are stored with the Regional Fire Effects Monitoring Program Manager in the Pacific West Regional office in Oakland.

All data and work schedules for additional projects (see section below on Additional Projects) are stored on the fire effects crew computer in the central room of fire effects office (c:\projects). Data files are backed up on the parks' LAN (j:\data\plants\fire_effects\sequoia_mortality,sequoia_seedlings, pine_fuel_mitigation, sequoia_heavy_fuel_effects\primary_data). Plot locations for other projects are being obtained and will be added to the permanent plot database on the network.

A report prepared annually summarizes program accomplishments and monitoring results and is distributed to the park staff, the Regional Program Manager, and other interested parties. The annual reports are stored on the parks' LAN (j:\data\plants\fire_effects\vegetation_fuel_fmh\products\annual_reports).

Quality Control

Quality control is of the utmost importance in all aspects of the vegetation and fuels monitoring program. Without high quality data the monitoring program cannot accurately assess whether management objectives are achieved. Therefore, multiple levels of quality control will be performed at all stages of the program using the following techniques:

1) Data Collection

a) Training – At the start of each season, several days of sampling protocol training where each protocol is demonstrated and then each employee performs the protocol. This training is followed by a practice plot session where all protocols are practiced in a real plot setting.

b) Periodic in- field comparisons – A few plots are randomly selected (up to 10%) and for these plots the data are collected independently by two different observers. The data from the independent observations are compared to examine the precision of the data. This technique is most useful to point out areas where measurement error is most

problematic and to increase awareness of field protocols where more care is needed in measurement.
c) Field Data Checklist (see Attachment 1) – For each plot visit, a checklist of all field tasks is filled out and the lead monitor makes sure that the checklist is complete and that all completed datasheets are placed in the plot folder before leaving the field site.

2) Data Storage

a) Quality Check Log (Attachment 1) – This log sheet is used to be certain that the data are entered into the database completely and accurately. After each field datasheet is entered into the database, the corresponding entry on the Quality Check Log is checked off, initialed, and dated by the person(s) who performed the data entry. At a later date, the field datasheet (raw data) is independently compared to the database and any errors in data entry are corrected. Each datasheet verified is checked off, initialed, and dated by the person performing the quality check on the Quality Check Log, which is stored with the data in the plot folder as a record of quality control. The Quality Check Log also serves as a place to record any questions or discrepancies found in the data or any information that needs to be gathered during the next visit to the plot.
b) FMH error checking function – Each datasheet entered is checked using the error checking function in the FMH software and any errors found are corrected.

3) Data Analysis

a) Identify anomalies – Any anomalous results which become apparent during data analysis are investigated for potential data errors. First, the corresponding field datasheets are examined for any visible errors and then compared to the database to check for errors in data entry.
b) Repeat analyses – Analyses are repeated in order to be certain that the correct analyses were performed and that the same results are generated.

Program reviews will occur periodically, either every 5 years, or at the request of the park Ecologist (Fire Effects), park Fire Management Officer, or the Regional Program Manager.

Responsible Party

The Lead Biological Science Technician (Fire Effects), in coordination with the Ecologist (Fire Effects) is responsible for hiring and training seasonal fire effects monitors, collecting field data, storing data electronically, performing data quality checks, and assisting with data analysis as needed.

The Ecologist (Fire Effects), in coordination with the Supervisory Natural Resource Management Specialist and the Fire Management Officer, is responsible for developing monitoring objectives, determining the appropriate sampling design, managing the database (including backups and quality control), analyzing the data, and disseminating the results for the vegetation and fuels monitoring program.

Funding

Funding for vegetation and fuels monitoring will be obtained through the fire effects module of the FIREPRO analysis system that analyzes existing and future workload to determine

associated staffing and support costs. Individual project accounts will be used to cover any additional time needed beyond base funding to monitor burning plots and immediate postburn visits.

Additional Projects

The following studies complement the parks' network of vegetation and fuels monitoring plots and provide additional information important to the fire management program.

Increasing giant sequoia sample size
Because of their great size, giant sequoia tree density is very low in the standard 20 x 50 m forest plots. To increase the sample size of giant sequoia, we sample all, or a subset of, giant sequoia trees in prescribed burn units in the Giant Forest area prior to and following prescribed burning. Pre- and post- burn methods follow the FMH protocol for overstory tree sampling and can be combined with the FMH database for the Giant sequoia- mixed conifer forest monitoring type. The total number of giant sequoias sampled in this study to date is 983 trees in seven separate units burned between 1993 and 1999. This information will provide a sufficient monitoring sample depth over a long time period with which to assess the long- term effects of prescribed fire on mature giant sequoia trees. Monitoring will continue for trees currently sampled, however, no additional giant sequoias will be added to the sample unless specific reasons warrant it.

Giant sequoia seedling survival in reburns
The issue of subsequent burns, following the initial restoration burn, has recently become more timely. Some areas of the parks where early prescribed burning efforts were concentrated have already surpassed the historic fire return interval without subsequent burning. In some of these areas, giant sequoia regeneration of varying density resulted from the initial burn. Knowledge about fire effects on these young trees following subsequent prescribed burns is critical, especially given the importance of giant sequoias and their fire- dependent regeneration. Plots were installed in reburn areas specifically to assess the reburn mortality/survival of groups of giant sequoia seedlings that established after the initial burn. This information may be helpful for decisions related to reburn scheduling in other areas in the parks.

Sugar pine pre- burn litter/duff removal
Large tree mortality following prescribed fire is a concern for land managers attempting to reduce fuels and restore the process of fire in fire- dependent ecosystems. Pines, including sugar pine seem to be especially susceptible to mortality following fire. Whether this mortality is directly related to returning fire after a long absence in short- return interval regimes, or a combination of fire and other previously existing stressors (e.g. white pine blister rust), is unknown at this time. Whether the current density of large pines falls within the range that would be present if fire regimes had not been disrupted is also unknown. Research scientists from the USDA Forest Service Riverside Fire Lab have found that removing the deep organic layer around trees prior to burning reduces large tree mortality. This type of pre- burn fuel removal may be an option in areas where large tree mortality is an important sociological or ecological issue. To see whether a difference in mortality occurs between trees with fuels removed and trees without fuels removed, and also to test the practicality of methods, fuel has been removed around large sugar pines in several prescribed burn units.

Heavy fuel effects on giant sequoia

As a result of public concern about the visual effects of fire, giant sequoia trees located in restoration prescribed burn units were previously subject to pre- burn fuel removal treatment. Unnaturally heavy fuels had been removed around giant sequoia trees in order to limit bark char and crown scorch on trees four feet or larger in diameter. This study was undertaken to determine the relationship between the amount of heavy fuel and duff surrounding giant sequoia trees prior to burning and the resulting fire effects characteristics after prescribed burning. Sixty giant sequoias in the Atwell Grove were selected and studied prior to burning. Data collected include: in a 25 ft radius around each tree, mapping and tallying 1000- hr fuels and litter and duff depth; depth and width of all fire scars; bark char; crown scorch height; and crown scorch percent. Although the fuel clearance procedures are no longer in place, the results from this study provide information to address issues of fire effects on giant sequoia trees.

Wildland- Urban Interface

In response to the National Fire Plan (2001), Sequoia and Kings Canyon National Parks identified Wildland- Urban Interface (WUI) areas that are treated to reduce the threat of damage to structures (both public and private) from wildland fire. This treatment involves the removal of fuel (both dead and live vegetation) from around the structures and includes mechanical thinning of small trees and brush, piling surface fuels, and burning the resulting piles of fuel removed.

Specifications for the fuel removal work will be located in individual mechanical treatment plans. In order to determine whether the treatments have been effective, pre- and post-treatment monitoring is carried out according to the following general protocols that may be adjusted depending on the project area:

- Prior to treatment, permanent plots will be installed along the outside edge of the project area (200 feet from structures) looking back in towards the developed area. Previous experience has shown that 15- 20 sample points will generate adequate data to represent the area statistically, and these points should be distributed evenly around the project area. The sample point will be marked by a single rebar stake, that will be painted orange to facilitate relocation. The rebar stake will have a tag that identifies the project name and plot number.

- A photo series estimate of the total woody fuel load will be taken from this point looking back into the project area with the plot centerline being perpendicular to the outside edge of the project. The photo series estimate will go out from the sample point at 45 degree angles from either side of the stake out for 100 feet. The total fuel load estimate will be recorded along with the plot number.

- At each point, 100 feet in to the project area along the plot centerline, a chaining pin will be placed into the ground. A tape measure will be swung around this chaining pin for a radius of 100 feet. All trees less than 40 feet tall within this radius will be recorded. Trees that are close to 40 tall will be measured using a clinometer and tape, to accurately estimate the tree height.

- The plot will be reread immediately following the completion of the project to determine if the objectives have been met, and then every 10 years to determine a maintenance schedule.

When the total woody fuel load exceeds 12 tons/acre, additional piling of fuels and burning of the piles will occur. When the total number of trees less than 40 feet tall exceeds 25/acre, additional thinning, piling and burning will occur. When maintenance activity occurs, the plots will be reread to assure the treatment objectives are being met. The area will be maintained into the future so that the project objectives are met.

- The Fire Monitoring Crew Supervisor, in coordination with the Fuels Specialist and Assistant Fuels Specialist, is responsible for completion of the WUI monitoring work.

In addition to monitoring the treatment objectives (above), comparing the results of mechanical fuel removal with similar areas treated with prescribed fire may provide useful information to evaluate the effects of alternative fire management activities. Up to 3 standard fuel and vegetation monitoring plots will be installed within the project area in order to compare results to those from similar areas treated with prescribed fire. Although only limited information will be gained from such a small sample size, differences in vegetation composition and patterns may be documented and investigated further if necessary. Fuel accumulation rate and tree regeneration will also be documented in the plots. The Lead Biological Science Technician (Fire Effects), in coordination with the Ecologist (Fire Effects), is responsible for implementing this supplementary WUI monitoring.

Due to additional concerns about the potential for non- native plant invasion into disturbed areas, directed surveys may be conducted in the WUI treatment area. With assistance from the parks' exotic plant program staff, the status of pre- treatment presence of non- native plant species may be determined along with any changes that may occur following initial treatment and after further treatment. Specific protocols have not yet been developed.

Management Implications of Monitoring Results

Recent policy and program initiatives recognize that fire reintroduction is important to fire-maintained landscapes to sustain diverse, functioning ecosystems and to prevent damage from uncharacteristically severe fire that is inevitable with fire exclusion in fire prone areas. Information about the results of fire restoration efforts supplied by the monitoring program is critical feedback needed by land managers, policy- makers, and the public.

The accomplishment of hazard reduction and restoration goals depends upon having a monitoring program that is sufficient to determine whether specific fuel reduction and structural restoration objectives are met. The vegetation and fuels monitoring program results provide the information needed to assess whether specific objectives for the prescribed fire program are met with the level of certainty required. The monitoring program provides a consistent and dependable method of documenting the prescribed fire program's objective achievement. If the objectives are not achieved, managers must determine whether management actions need to be adjusted in order to attain objectives or if the management objectives need to be revised given the current situation. The analysis of some additional data not specifically related to management objectives is used to determine if any unexpected consequences of prescribed fire occur.

Each year, the Ecologist (Fire Effects) documents the latest vegetation and fuels monitoring program results in an annual report and, unless no new results are available, presents these

results to park managers and local scientists for review in an informal meeting setting. This meeting usually takes place in late winter or early spring. At this time, the group discusses current and preliminary results and makes decisions about any changes needed in either the monitoring program or management activities based on these results. Adaptive change(s) should take place if any of the following are apparent from the monitoring results:

- objectives are not sufficiently met
- an undesirable trend is occurring
- an unexpected result occurs
- monitoring methods cannot adequately assess objectives.

Any changes made, such as adjustments to burn prescriptions, changes or additions to monitoring protocols, or modifications of target conditions or management objectives, should be documented at the earliest opportunity in the appropriate section of the Fire and Fuels Management Plan.

E. ADDITIONAL FUELS INFORMATION FOR MODELING

Recent advances in computer technologies have given managers more tools to help make critical resource management decisions. The development of a Geographic Information System (GIS) based fire spread model called FARSITE, is an example of one of these tools. The FARSITE model, like most models, requires quality- input data in order to produce reliable output. The fuels model and canopy characteristic data are the most important inputs to any fire growth model. Fuel load information is also needed for smoke emissions modeling. These information needs require additional fuels data beyond that which is collected in the current parks' vegetation and fuels monitoring program. Currently, the fuel model map for Sequoia and Kings Canyon National Parks is based on 1970's vegetation maps. In addition to accuracy and quality problems, this map lacks some of the attributes necessary to make the best use of new technology (e.g. canopy bulk density and height to live crown base). A new vegetation and fuels mapping effort for the parks is currently underway and will help to correct the deficiencies of the outdated maps. Until that project is complete, additional fuels information collected allows for improved modeling to assist in fire management decision- making processes.

Monitoring Goal: Additional fuels information provides for the most current and accurate fire behavior and spread and smoke emissions modeling critical for making sound fire management program decisions.

Monitoring Objectives

1. Develop and improve on the Geographic Information System (GIS) data themes used to run fire behavior and smoke modeling programs.

2. Install enough permanent fuels plots in the short- needle and long- needle conifer forests, so that the percent error of the total fuel load estimate is less than 20% (percent error is calculated by dividing the standard error by the mean and multiplying by 100).

Sampling Design

The sampling design is intended to capture the fuel load data necessary to run the fire behavior model and smoke modeling programs as efficiently as possible. The study focuses on the forested areas of the park where the fuels are continuous enough to easily support fire spread, from the ponderosa pine- mixed conifer community (4000- 6500 feet) to the red fir forest (8000- 10000 feet). Based on previous experience, permanent fuel plots are located in the short-needle (includes sequoias) and long- needle conifer forest types in the following elevation classes: low [• 6500 feet (1982 m)], mid [6500- 8000 feet (982- 2439 m)], and high [> 8001+ feet (2440 m).

Field Measurements

Permanent fuel plots are established in order to track fuel accumulation over time. The permanent fuel plots are established using the planar intercept method (Brown 1974). The plots consist of four 50 foot transects running north, south, east and west from the center point. Ten litter and duff measurements are taken along each of the 50 foot transects.

Tree basal area is measured at each permanent plot using Basal Area Factor (BAF) prisms. The prism is selected so that a minimum of five trees would be included. The prism is swung 360• around the sampling point and the number of trees that are "in" (edges still touching, not totally offset) is recorded along with the factor number of the prism used. Every other borderline tree is counted. Three overstory trees are selected as being representative of the average diameter "in tree" and their diameter at breast height (DBH) is measured and recorded. An average value is calculated from the three trees measured and used to represent the trees at that sampling point.

The following measurements are also recorded at each permanent plot using a clinometer: overstory tree height, height to live crown base for each distinct canopy layer (dominate, intermediate, understory). Canopy cover is measured with a densiometer and recorded using the following codes: 0=0%, 1= 1- 20%, 2= 21- 50%, 3= 51- 80%, and 4= 81- 100%.

Timing of Monitoring

The permanent fuel plots will be re- measured every 5 years to track fuel accumulation over time and within 1 year following a disturbance (usually a fire) and thereafter will follow the 5 year schedule.

Monitoring Plot Relocation

All monitoring plots are permanently marked with painted rolled steel bars (rebar) with labeled tags denoting their plot type and number (e.g. Permanent Fuel Plot #20). All plots have written descriptions of their location, are added to the GIS plot location database each year, and are geo- referenced using a GPS unit. The plots will be relocated using a combination of the above references. Copies of all plot location descriptions are stored in a Permanent Fuel Plot binder in the fire monitoring crew supervisor's office. All updated fuel plot locations (UTM coordinates) are stored on the parks' LAN (j:\data\fire\fuels\gis\pfplocdt.dbf).

Data Analysis

New plots will be installed until we reach our goal of less than 20% error for the total fuel- load estimate for each needle type (short vs. long). We will update the database and GIS themes as new data is acquired.

Data Sheet Examples

Fuel data and stand data field forms have been developed (see Attachment 1).

Information Management

The database is stored on the parks' LAN (j:\data\fire\fuels\gis\MkSumoo.xls. All hardcopy files, the digital data files, and digital photo files are located in the fire monitors' office at the parks' Ash Mountain headquarters. The updated data files reside on the Fuels Specialist computer (C:\My Documents\Fuel\MK- Data\MkSumoo.xls). The most current copy of the database files are backed up on the fire monitoring crew computer in the main room of the office (C:\Crew\Monitors\FuelLoad\99PFP\Mksum.xls) and on floppy disks.

Quality Control

Quality control is important and will be performed during data collection, data storage, and analysis stages.

Responsible Party

The Fire Monitoring Crew Supervisor, in coordination with the Fuels Specialist, is responsible for training seasonal fire monitors, collecting field data, storing data electronically, performing data quality checks, and assisting with data analysis as needed.

The Fuels Specialist, in coordination with the Supervisory Natural Resource Management Specialist and the Fire Management Officer, is responsible for developing monitoring objectives, determining the appropriate sampling design, managing the database (including backups and quality control), analyzing the data, and disseminating the results.

Funding

Funding for the fuels monitoring will be obtained through the prescribed fire management and fire use modules of the FIREPRO analysis system that analyzes existing and future workload to determine associated staffing and support costs.

Management Implications of Monitoring Results

Improvement in the quality of the fuels related input data needed to run current and future modeling programs will result in a higher degree of confidence in the outputs and ultimately yield a more informed management decision. As we improve the underlying data that feeds the models, the outputs from the model should more closely match reality.

F. WILDLIFE

Many wildlife species are affected by fire, with significant effects to both the structure and vegetative composition of habitat. Because of these fire- induced changes in habitat and because rodents are sensitive to habitat changes, they make good indicators of wildlife response to individual fires. Changes in rodent populations indicate changes in available food for raptors and forest carnivores that that are either sensitive or simply of public interest (e.g. fisher, martin, goshawk, etc.) since rodents are at the bottom of the food chain. Also, changes in mid- sized mammal occurrence provide limited indication of changes in relative abundance of forest carnivores that may feed on the rodents. Currently, wildlife monitoring does not occur in wildland fire areas but is focused on areas where prescribed fire is the primary management activity.

Monitoring Goal: Provide information useful to determine whether wildlife species diversity is maintained and to evaluate the effects of the prescribed fire program on wildlife populations.

Monitoring Objectives

1. Provide documentation of long- term changes in rodent populations and their habitat following fire under known conditions.

2. Acquire inventory of rodent species and their relative abundance within both common and unique East Fork Kaweah environments (habitats) to facilitate assessment of potential fire effects.

3. Acquire inventory of mid- sized forest carnivores and other mammals of similar size and their relative abundance within East Fork Kaweah environments (habitats) to facilitate assessment of potential fire effects.

4. Maintain an inventory of elderberry shrubs (*Sambucus mexicana*) within the Ash Mountain prescribed fire treatment areas to protect habitat for the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*).

Sampling Design

Rodent populations were investigated from two perspectives: 1) long- term monitoring of select areas, and 2) serendipity surveys of the most common and unique habitats. The long- term monitoring is intended to document long- term changes in rodent populations and their habitat following fire under known conditions. Serendipity surveys inventory rodent species and their relative abundance within both common and unique environments to facilitate large- scale assessment of potential fire effects.

Long- term Monitoring
Long- term monitoring plots are located in representative examples of the most significant combustible vegetation types in the East Fork Kaweah Drainage. Existing plots are located in mixed chaparral, sequoia grove, westside ponderosa pine forest, and Jeffrey pine forest. Long-term monitoring plots are 1 ha in size (75 m by 135 m with surface distances adjusted for slope).

Plots are numbered sequentially 0, 1, 2, 3. Each plot consists of 60 stations positioned at 15- m intervals (Distances are adjusted for slope.). Traps stations are numbered 1 to 6 from bottom to top and 0 through 9 from left to right. 23 x 8 x 9 cm Sherman live traps (40 x 8 x 9 cm Sherman live traps for sites where wood rats are common) are placed within 1m of the trap station marker. The traps are placed on firm substrate. If firm substrate is not available within 1m of the stake, such as where there is deep litter, use the most stable site available. The trap is either flat or the rear is slightly higher than the front of the trap. The bottom of the trap should be nearly flush with the surface of the ground. The trap should not sit below the surface of the earth. A wad of cotton is placed in the rear top corner of the trap. It is pressed in to keep it as far from the entrance as possible and above the trigger. Externally, the trap needs to be insulated if there is any potential for the sun to shine on the trap. This can be done with corrugated cardboard or other insulating materials. The insulation needs to extend beyond the widest dimensions of the trap to prevent the sun hitting the trap at any time of the day.

The traps are baited with a mixture of rolled oats and peanut butter. The bait is mixed so that the flakes of rolled oats are dry and mostly not sticking together. A small handful (large pinch) of bait is thrown into the traps in such a way that bait will concentrate in the rear but be scattered throughout the length of the trap. A thin stream of bait goes out the door for several decimeters.

Serendipity Surveys

For serendipity surveys of rodents, no formal plots exit. The areas surveyed are selected to provide comprehensive coverage of all significant habitats within the drainage. The area should be at least a hectare in size and of uniform habitat. The area should be large enough to eliminate captures from adjacent communities. The size and methods for setting traps are the same as for long- term plots except that spacing is not critical. Rodent traps are distributed loosely at approximately (not measured)15 m intervals. Each trap has a unique number.

For serendipity surveys of medium- sized mammals, no formal plot exists. The habitats being surveyed (except riparian) should consist of at least 50 hectares of similar contiguous habitat. The habitat should be sufficiently extensive to virtually eliminate captures of individuals that are not at least partially dependent on utilization of the habitat being sampled. One or more traps are distributed at sites that appear to be suitable (good access, good cover, away from visitors, etc) for setting traps with no specified spacing. Each trap site has a unique designation. To capture mid- sized mammals, 81 x 26 x 41 cm Tom- A- Hawk live traps (107 x 40 x 52 cm Tom- A- Hawk traps when targeting larger mammals) are placed on firm substrate. If firm substrate is not available, use the most stable site available. The trap is either flat or the rear is slightly lower than the front of the trap. The bottom of the trap should be nearly flush with the surface of the ground. The trap should not sit below the surface of the earth. The trap is completely covered with burlap bags except for the entrance. Before setting any trap, check the trigger and adjust as necessary for proper sensitively to closing. Bait the trap with fish- flavored cat food. Place a lump of bait (size of two walnuts) behind the trigger, and place a trail of bait (peanut- sized lumps) at about one decimeter intervals extending through the trap and about a meter out the door. Every couple of days, the bait needs to be replaced.

Field Measurements

Captured rodents are ear tagged, and minimal recorded information includes tag number, capture location, date, habitat, species, sex, age (adult, subadult, juvenile), weight, hind foot

length (first capture), ear notch length (first capture), tail length (first capture), number of trap-nights, and general comments.

At long- term monitoring plots, the minimal habitat data includes shrub and tree species composition, shrub basal diameter, shrub stem density, tree DBH, tree density, slope, aspect, elevation, air temperature, and general site description.

For mid- sized mammals, minimal recorded information includes species, location, date, habitat, number of trap- nights, and general comments.

For elderberry shrubs (*Sambucus mexicana*), monitoring methods are described in the Ash Mountain burn plan (regarding habitat for Valley elderberry longhorn beetle, *Desmocerus californicus dimorphus*).

Timing of Monitoring

Long- term Monitoring
Monitoring on long- term plots occurs during the summer prior to the burn and annually for at least three successive years following the burn. Monitoring event duration normally lasts three to six weeks but can be longer (depending on trapping results). Currently, trapping occurs for four consecutive nights during each week. Monitoring periods require temporal overlap between successive years to permit comparison of population changes from year to year.

Serendipity Surveys
Serendipity surveys generally last approximately 2 weeks with a goal of capturing the common species in areas where we have little understanding of populations present. Similar to long- term monitoring, trapping often occurs for four consecutive nights during each week. If uncommon species occur, survey duration may be increased.

Monitoring Plot Relocation

Long- term Monitoring
GPS coordinates have been field measured for all four corners of each long- term monitoring plot. Plots are marked with rolled steel bars on each corner and at 15 m intervals within using one- quarter inch rolled steel rods that extend approximately one foot above the ground. Each stake is numbered with an aluminum tag.

Serendipity Surveys
For serendipity trapping, a GPS coordinate is either field measured or taken from a map to record the approximate center of the sampling area.

Data Analysis

Plot populations are estimated using a modified Jolly- Seber Method. Postburn population trends are compared to pre- burn population. Postburn populations are compared in successive years. Both catch rates and population estimates are used to evaluate populations. Capture rates at unburned plots in other portions of the drainage help distinguish fire effects from intrinsic rodent population dynamics.

Data Sheet Examples

Data sheets for both plot data and serendipity data have been developed (see Attachment 1).

Information Management

Original data sheets and reports are stored in the office of the Wildlife Ecologist. Photocopies are made of datasheets at the earliest opportunity. The data reside on the Parks' LAN, accompanied by appropriate metadata (j:\data\animals\vertebrates\wildlife_fire_effects\primary_data). Data stored on the Wildlife Ecologist's computer is backed up and stored on a separate medium and generally in a different building (Wildlife Biologist or home).

Quality Control

The accuracy of species identifications and adherence to protocols is achieved through training at the beginning of the season. Crewmembers are not sent to the actual plots for data collection until they have demonstrated competence in doing the required work, unless the are accompanied by someone who is already competent. Periodic field visits by the supervisor serve as intermittent checks on the accuracy and completeness of the data collection effort.

Data is transferred from the data sheets to the digital databases as a team effort. Data is entered and then checked against the data sheets to assure accurate copy. Database accuracy is spot checked by the analyst prior to analysis.

Responsible Party

The parks' Wildlife Ecologist is responsible for planning the annual work, managing the funds, hiring the crews, analyzing the data, and preparing the annual report.

Funding

The data collection and data entry for the monitoring is supported by FIREPRO. Data analysis and reporting is supporting by the parks' Wildlife base account.

Management Implications of Monitoring Results

If monitoring results show large changes, such as losing species or gaining unexpected species, an evaluation is warranted. This evaluation would include determining if current prescriptions are appropriate for the known fire regime of the vegetation type or whether further research is needed to determine the historical fire regime.

G. WATER

The effects of fire on water quantity and quality and sediment transport are second order fire effects that have important ecosystem consequences. Stream flow and water chemistry monitoring is focused on specific watersheds where prescribed fire is the primary management activity, although wildland fires have occurred in some parts of the study areas.

Monitoring Goal: Evaluate the effects of prescribed fire on water quality and quantity in first order streams as well as across an entire watershed.

Monitoring Objectives

1. Evaluate changes in hydrology following prescribed fire by measuring pre- fire and post- fire continuous stream discharge.

2. Document changes in hydrochemistry by quantifying solute inputs using wet deposition data from the National Acid Deposition Program (NADP) and California Air Resources Board (CARB) collection sites and solute exports using stream discharge and periodic chemical samples.

3. Assess the indirect effect of prescribed fire on erosion and sediment transport that might affect water quality.

Sampling Design

The watershed approach requires that many key aspects of the hydrological and biogeochemical cycles are measured and sampled to get a full understanding of the variability in watershed processes. The Sequoia watershed program has used a holistic approach by establishing co-occurring sites to measure meteorology, stream discharge, and hydrochemistry. Many of the sampling protocols have been in place since the watershed program was initiated in 1982.

Paired watersheds were located in the Middle Fork of the Kaweah drainage. Log Meadow is a mid- elevation (2100 m) montane mixed- conifer catchment dominated by white fir (Abies concolor) and giant sequoia (Sequoiadendron giganteum). Precipitation averages 100 cm annually, approximately half falls as snow during the winter months. Dominant soil types include Pachic and Lithic Xerumbrepts, Xeric Haplohumelts, Aquepts, and Cumulic Haphibrepts. Tharp's (13.1 ha) and Log Creeks (49.8 ha) are paired first- and second- order watersheds, and are instrumented with Stevens Type F Water Level Recorders and Stevens Type A/F Electronic Data Loggers on 3" and 12" Parshall flumes, respectively.

Additional sites were established in 1995 to meet the needs of fire management when a large project in the East Fork of the Kaweah River (originally called the Mineral King Risk Reduction Project) was funded. This project was initiated to determine whether accelerating the application of prescribed fire across an entire watershed was feasible and to document the costs and effects of such a landscape- scale program. Monitoring of hydrology and hydrochemistry of this entire watershed is intended to provide information that may be applicable to other large watersheds.

The East Fork Kaweah watershed encompasses approximately 21,000 ha with elevations ranging from 875 m to 3,750 m. Vegetation within the watershed is diverse, ranging from chaparral and hardwood forests at the lower elevations to mixed conifer and Sequoia forests at mid elevations. Alpine vegetation is found above 3,100 m. Trauger's Creek and Deadwood Creek are the primary focus for the stream chemistry and hydrology study.

Trauger's Creek is a low elevation (1400 m) catchment (106 ha) with mixed chaparral/oak-woodland in a transition zone between the lower mixed- conifer zone and the upper chamise-chaparral zone. The dominant species is California live oak (Quercus, sp.). Incense cedar (Calocedrus decurrens), maple (Acer macrophyllum), California laurel (Umbellularia californica), spicebush (Calycanthus occidentalis), and willow (Salix, sp) are found along the stream corridor. Precipitation is measured by a tipping bucket at Lookout Point, two miles west of the study and is operated by the National Park Service.

Deadwood Creek is a mixed- conifer (2000 m) catchment (100 ha) characterized by white fir (Abies concolor), red fir (Abies magnifica), giant sequoia (Sequoiadendron giganteum), and incense cedar (Calocedrus decurrens). Precipitation measurements for this site are recorded at the Atwell Mill stables, approximately one mile west, by the Army Corps of Engineers.

Field Measurements

Hydrology
Disturbance such as fire can result in dramatic increases in peak and total discharge. Pre- and post- fire hydrologic measurements will allow us to quantify the magnitude of those changes in the study catchments. Continuous discharge records before and after fire will identify any shifts in the magnitude and duration of high flow, as well as reveal changes in base flow. In addition, discharge records are essential for determining mass balances of solutes, necessary for determining the effects of air pollution and climatic change on southern Sierran catchments.

Study watersheds are equipped with data loggers and/or chart recorders that record hourly or daily discharge. Several types of loggers and recorders are used, including Stevens type A/F records and Omni Data loggers. The Middle Fork Kaweah sites are fitted with weirs that provide direct stage- discharge relationships, which were established by the U.S. Geological Survey/Water Resources Division (USGS/WRD) staff. The Log Meadow sites are no longer being monitored but could easily be re- instrumented if desired, provided funds were available. The upper East Fork Kaweah sites are currently maintained by NPS staff. The headwater Marble Fork watersheds are gauged and monitored by UCSB staff. The lower East Fork Kaweah and Marble Fork Kaweah are gauged by Southern California Edison power company. Stage-discharge relationships are being developed for the East Fork Kaweah streams using the salt dilution method.

Hydrochemistry
Mass balance determination for solutes in Sierran streams require the analysis of both precipitation chemistry and stream chemistry. Some of the effects of fire, atmospheric deposition, and climate change on Sierran catchments are determined by evaluating mass balance relationships. In addition, pre- and post- fire hydrochemistry measurements are necessary to quantify the magnitude of changes in streams solute concentrations following fire.

We will use stream chemistry data to determine pre- and post fire base flow and high flow chemistry output and transport patterns in the study watersheds. We will also use these data to monitor the effects of changes in air quality as seen by changes in stream chemistry output.

Stream samples are collected weekly throughout the year. Additional samples are collected during periods of high flow (storm events and snowmelt). This sampling frequency will allow us to look at both inter- and intra- annual variation. Samples are collected and processed according to protocols outlined by Robert Stottlemeyer (1987. Monitoring and quality assurance procedures for the study of remote watershed ecosystems. Special Technical Pub. No 940. American Soc for Testing and Materials. pp. 189- 198.). Samples are filtered at the Ash Mountain Water Lab (AMWL) and shipped to the Biogeochemistry Laboratory at the Rocky Mountain Station Experiment Station in Fort Collins, Colorado, for analysis of base cations, ammonium, nitrate, sulfate and phosphorus. A separate filtered sample is shipped to Michigan Technological Institute for dissolved organic carbon analysis. Alkalinity, pH and conductivity are measured at the AMWL.

Timing of Monitoring

Sampling is done throughout the year, monthly for hydrochemistry and continuously for hydrology. Stage heights recorders are placed in the streams and continuous data includes average hourly heights which is then calculated to flow (liters/day or gallons/day). Sampling began in the East Fork Kaweah watershed in 1995 to characterize pre- burn conditions.

Monitoring Plot Relocation

Sampling sites occur at the intersection of the Mineral King Road and Trauger's Creek and at the intersection of the Mineral King Road and Deadwood Creek. Log Meadow sites can be located by map and stream discharge instrumentation. Maps of the Log Meadow sites are stored as hard and electronic copies in the Aquatic Ecologist's office.

Data Analysis

Hydrology results will be used to determine the influence of landscape scale and geomorphology on watershed response to fire. Studies following the Yellowstone fires of 1988 indicated that low order streams are more affected by fire because small watersheds tend to experience fire over a larger percent of the catchment. However, the magnitude and quality of those effects are also influenced by stream gradient, aspect, and riparian area. The pilot study in the mixed- conifer Log Meadow watershed examined the effects of a single fire on a single small (<50 ha), low gradient watershed. In contrast, ongoing landscape- scale burning in the East Fork Kaweah watershed provides a unique opportunity to evaluate fire effects on watersheds at two very different scales: large (ca. 21,000 ha) and small (ca. 100 ha).

Geomorphology, stream characteristics, vegetation, and fire behavior in the East Fork Kaweah watershed differ from those in the Log Meadow watershed. The East Fork Kaweah catchments are larger and steeper (30 - 45% slopes). Trauger's Creek catchment comprises mostly Quercus spp. (rather than conifer forest) and sediments are more coarse. These differences allow characterization of a range of watershed responses to fire. Specifically, the effects of fire along an elevational gradient will be evaluated by comparing changes in Trauger's and Deadwood

catchments. Post- fire responses in hydrology and hydrochemistry in Deadwood Creek and Tharp=s Creek (burned in 1990), which have similar vegetation types, will be compared. Additionally, the magnitude of watershed response to fire will be evaluated by comparing post-fire hydrochemistry in smaller catchments (ca. 100 ha) with the East Fork Kaweah drainage as a whole (ca. 21,000 ha).

Hydrochemistry results will determine how fire effects the nitrogen and sulfur cycles in small watersheds, and at what spatial and temporal scale are these effects most pronounced. Previous work at Sequoia National Park has documented chronic deposition of anthropogenic pollutants and a slow, long- term increase in nitrogen deposition. In contrast, the park's pilot study of fire effects on hydrochemistry revealed sharp peaks in post- fire nitrate and sulfate concentrations, far above any level recorded in the absence of fire. Nitrate and sulfate levels have remained elevated for at least five years following our experimental burn.

Analyses will attempt to determine whether these findings are unique in time and space, or if can they be generalized to watersheds of different sizes, vegetation types, gradients, and elevations in the Sierra Nevada. While otherwise undisturbed Sierran streams are not presently suffering chronic acidification, the combined influence of increased atmospheric deposition and elevated post- fire acid anion concentrations might lead to acidification. Determining the importance of antecedent conditions, such as prolonged drought (preceding the pilot study on fire effects) is also of interest. In addition, analyses should help to establish if fires result in permanent (relative to the fire return interval) changes in hydrochemistry.

Information Management

Data management protocols are well established, and will be continued. Existing databases include a master file of hydrochemistry data, daily discharge files for gauged streams, and meteorology files for weather stations at several elevations within the Parks. All data are stored in the Ash Mountain watershed lab computer and backed up daily. Weekly, monthly, and annual tape backups are archived. Weekly off- site backups are maintained. The data will also reside on the Parks' data management system accompanied by appropriate metadata.

Quality Control

The SEKI watershed research program has maintained a standard set of protocols since its inception in 1982. QA/QC procedures, detection limits for analyses, and the results from national audits are documented. Copies of the annual QA/AC reports from the 1980's are in the Aquatic Ecologist's office. The QA/QC reports from the 1990's were included in the annual reports and the latest (2000) is also included in the proposed 5- year watershed plan. In the past, our results have been well within the range of required standards for each study. The watershed lab will continue to participate in semiannual audits.

Responsible Party

The Aquatic Ecologist will be responsible for implementing funded components of the program in collaboration with the fire staff. This position is also responsible for working with the fire staff to obtain funding.

Funding

Currently, only part of this program is funded. The East Fork Kaweah hydrology and hydrochemistry work is currently being funded by FIREPRO. Of the three original Sequoia watershed study sites, the Log Meadow and Elk Creek sites are currently unfunded and the Emerald Lake site is being funded by EOS (NASA global change program). Funding is sought to add a sediment transport component to the program.

Collateral Components

Meteorology
Meteorological data are needed to quantify mass balances, assess intra- and interannual variability in ecosystem process, model ecosystem processes, or determine mechanisms driving patterns. Baseline meteorological data collection will continue at established sites in the Middle Fork Kaweah and East Fork Kaweah watersheds operated jointly by the U.S. Geological Survey/Biological Resources Division (USGS/BRD), National Park Service (NPS), National Oceanic and Atmospheric Association (NOAA), University of California, Santa Barbara (UCSB), and the U.S. Army Corps of Engineers (COE).

Precipitation Chemistry
Analysis of precipitation chemistry is central to determining mass balances of solutes entering Sierran catchments. Many years of continuous data collection are required to quantify inter-annual variation and to identify long- term trends in atmospheric loading. These data will be used to monitor changes in atmospheric deposition and to provide a baseline for the fire studies.

Unfunded Components

Sediment Transport
Increases in erosion and sediment transport are among the most dramatic and potentially deleterious effects on water quality indirectly associated with fire. Sediment transport is not currently a component of the parks' fire monitoring program, however, it has been identified as an important information need and one for which funding is desired. Erosion and sediment transport information is critical to evaluate indirect effects of fire on water quality, an important and timely social issue that would assist in fire management planning. In addition, sediment transport is important to understand ecosystem effects such as changes in stream chemistry and aquatic biota.

Macroinvertebrates
A baseline study of pre- fire aquatic macroinvertebrate assemblages conducted by Ian Chan, University of California, Davis, provides critical information on the current aquatic communities in small Sierran watersheds. The park could use Chan's study as a baseline for post- fire monitoring to track the response and recovery time of communities to fire, while further enriching our understanding of biological diversity along structural and temporal axes. This work would facilitate future fire management planning and enhance the parks' ability to provide fire- effects information to the public.

Management Implications of Monitoring Results

The striking chemical response of the pilot experimental watershed in Giant Forest to fire led to incorporation of further watershed studies on streams feeding the East Fork of the Kaweah River as an element of the landscape- scale prescribed fire project. This experimental effort to reduce fuels and restore more typical ecological function to an entire watershed provides a valuable opportunity to measure the physical, chemical, and biotic effects of landscape- scale burning on streams, and on the river systems they feed. For example, fire- induced changes in stream chemistry and sediment loading can have significant effects on fisheries and reservoirs, respectively. Alterations in forest structure result in changes in hydrodynamics that can significantly affect the efficiency of water- storage and release systems. Continued monitoring in the East Fork Kaweah will allow us to evaluate recovery rates of affected parameters such as nitrogen and sulfur constituents, pH, and alkalinity.

H. FIRE REGIME

One of the primary goals of the parks' fire management program is to restore fire as an ecosystem process across the landscape. As a result, we need to both understand the underlying baseline processes and be able to measure the success of the program's efforts at restoring and maintaining this process.

Fire regime can be defined as the interactions–from simple to complex–of a suite of attributes that constitute how fire operates as a process in a particular vegetation type or specific location. The attributes that describe the characteristics of a fire regime include: fire return interval (distribution, mean, minimum, maximum), season of occurrence, fire size and pattern, fire type (surface, crown, etc.), fire intensity (the quantity of heat produced), and fire severity (level of damage to what is affected by fire).

Important modifiers of these attributes include topographic features such as aspect and elevation, climate, and the lag effects of historic biotic events. Taken together, these attributes define fire as a process in a particular location and setting. Ideally the design of a program to monitor the restoration and maintenance of fire regimes would include the evaluation of all these attributes, however, available information is currently limited by our ability to acquire this knowledge and by the associated costs. Due to its landscape- level scope, fire regime monitoring encompasses all fire management activities occurring throughout all areas of the parks including wildland fires (both fire use and suppression fires) and prescribed fire.

Monitoring Goal: Fire regime monitoring provides information to evaluate the cumulative accomplishments of the fire management program in restoring and maintaining the natural fire regime over time across the entire landscape.

Target Conditions

Target conditions for fire return intervals (FRI) and season of fire for each major vegetation type have been determined based on our current knowledge (Table 5). These target conditions represent our best estimate of pre- Euroamerican settlement fire regimes for these two attributes (FRI and season of fire). Values have been derived from published literature, recent research findings, and local knowledge of park staff.

The range of fire return intervals (minimum to maximum) provides a broad window of possible fire occurrence, while the mean is the arithmetic mean of the fire return interval for the period from 1700 to 1860, the period when fire history reconstructions exist (Caprio and Lineback 1997). R_{max} is the average maximum fire return interval for a given vegetation type (see Caprio and Lineback 1997 for description of calculation) and is a conservative estimate of past fire return interval. Seasonal occurrence of fire under pre- Euroamerican settlement fire regimes was estimated and divided into categories of summer, early fall, and late fall/early winter seasons. Values are estimates of the percentage of area burned within each of these seasons for each vegetation type.

Table 5 – Target conditions by vegetation type for fire regime attributes (maintenance phase) and estimates of the quality of input information for the target condition values. R_{max} is the average maximum fire return interval.

Vegetation Type	Fire Return Interval Range	Season of Fire (% of area burned)
Ponderosa Pine- Mixed Conifer	1-15 years (mean = 4, R_{max} = 6) quality – good	0-30% Jun-late Aug 50-70% late Aug-Oct 30-50% Oct-Dec
White Fir-Mixed Conifer	1-30 years (mean = 10, R_{max} = 16) quality – good	0-20% Jun-late Aug 40-60% late Aug-Oct 30-50% Oct-Dec
Giant Sequoia-Mixed Conifer	1-30 years (mean = 10, R_{max} = 16) quality – good	0-20% Jun-late Aug 40-60% late Aug-Oct 30-50% Oct-Dec
Subalpine	50-1,500 years (mean = 187, R_{max} = 508) quality – poor	0-5% Jun-Jul 90-100% Aug-Oct 0-5% Nov-Dec
Xeric Conifer	15-60 years (mean = 30, R_{max} = 50) quality – very poor	0-20% Jun-Jul 50-70% Aug-Sep 10-30% Oct-Dec
Red Fir	9-92 years (mean = 30, R_{max} = 50) quality – poor	0-10% Jun-Jul 80-90% Aug-Oct 0-10% Nov-Dec
Lodgepole Pine	9-300 years (mean = 102, R_{max} = 163) quality – very poor	0-10% Jun-Jul 80-90% Aug-Oct 0-10% Nov-Dec

Vegetation Type	Fire Return Interval Range	Season of Fire (% of area burned)
Mid-Elevation Hardwood	1-23 years (mean = 7, R_{max} = 23) quality – very poor	0-30% Jun-late Aug 50-70% late Aug-Oct 30-50% Oct-Dec
Foothills Hardwood & Grassland	1-17 years (mean = 11, R_{max} = 17) quality – very poor	0-5% May-Jun 30-90% Jul-Oct 0-10% Nov-Dec
Foothill Chaparral	10-100 years (mean = 30, R_{max} = 60) quality – estimated *25% 0-20 yr old stands 50% 20-50 yr old stands 25% >50 yr old stands	0-30% Jun Jul 50-70% Aug Sep 30-50% Oct Dec
Montane Chaparral	?-? years (mean = 30, R_{max} = 75) quality – estimated	unknown
Meadow	?-? years (mean = 40, R_{max} = 65) quality – estimated	unknown

*Area of foothills chaparral vegetation in differing age classes was also defined as an alternative measure due to the difficulty in assigning specific FRI.

Monitoring Objectives

1. Track and evaluate the continued implementation of the restoration of fire into park ecosystems, and

2. Determine whether the continued occurrence (maintenance) of fire over the long term, either from natural or human ignition sources, falls within a target range as determined from specific resource objectives (see Table 5).

Sampling Design

Monitoring fire as a process is a relatively new concept for setting resource objectives in fire management planning. Process monitoring has two requirements: 1) a need to understand historic fire regimes which provide historic reference conditions on past processes, and 2) a method of measuring contemporary fire processes which can be compared against the past processes. The greater the precision of the historic and contemporary information the better the quality of the analysis. In most cases the historic process data is the limiting input. Additionally, historic data are nearly always from a specific interval of time in the past, therefore, longer- term

variability must be recognized when interpreting this information for planning purposes. For example, reference conditions may shift as a result of long- term changes in the drivers of fire regimes, such as climate.

Over the last 30- 40 years, most fire history information has typically been restricted to solely providing descriptive information on what past fire frequencies were like at particular locations. We can now monitor fire as a process because we have, or can obtain, fairly detailed information about past fire regimes for many vegetation types within the parks, particularly using tree- ring reconstruction methods. This detailed, fairly localized information may be applied to larger landscapes using GIS to extend the use of this information for fire management planning.

Our current sampling objects are to obtain pre- Euroamerican settlement fire regime information from the array of vegetation types that exist in the parks and to understand how the past fire regime varied across the landscape in differing topographic or biotic settings. When carrying out fire history sampling we will utilize standard field sampling and dendrochronological crossdating methods to provide the highest quality information. In some vegetation types alternative methods may be required.

Field Measurements / Baseline Information

Baseline information used in fire regime monitoring is derived from two sources, 1) a historic reference period, usually for a time period prior to Euroamerican settlement, and 2) from written records of fire occurrence with associated maps for recent decades. The historic reference information is usually the most limiting. It can be obtained from a variety of sources– anecdotal, cultural, and historic accounts or records (maps and photographs), composition and changes in vegetation assemblages and life history attributes of the particular species in relation to fire, plant community age structure, palynological records, or tree- ring based fire histories. Each comes with differing degrees of precision and length of record. Additionally, all may not provide useful information across all vegetation types or for particular locations on the landscape. Currently, the primary source of high quality historical process data is dendrochronological- based fire history reconstructions that can be obtained in many forested vegetation types. Such data has both explicit spatial and temporal precision to at least the annual level.

At present, knowledge about past fire regimes in the southern Sierra Nevada is generally poor with exceptions for specific vegetation types such as giant sequoia- mixed conifer, white fir- mixed conifer, and ponderosa pine- mixed conifer. A review of fire regime data for the parks suggested that good quality data only exists for vegetation types that cover about 26% of the parks (Caprio and Lineback 1997). Additionally, there is a poor understanding about how specific modifiers, such as aspect and slope, affect the fire regime in differing vegetation types.

Baseline fire regime information is needed for the complete array of vegetation types found in the parks. While some of this information can be derived using dendrochronological analysis of fire scars, in many cases other methods or sources of information will be required. In vegetation types where dendrochronological methods can be used, an unbiased inventory approach with good spatial replication would provide the highest quality data. Sampling would be a one- time process–long- term follow- up sampling is not required once the historic data is acquired. For

other vegetation types where dendrochronological methods are not feasible, information about past processes will be much less precise and more difficult to obtain.

Timing of Monitoring

A new FRID map will be produced annually as the time since last fire (TSLF) GIS layer is updated with all new fire perimeters after the end of each fire season. Additionally, when new pre- Euroamerican fire regime information is obtained that results in updated R_{max} values for specific vegetation types these will be incorporated into the annual FRID calculation.

At five year intervals more detailed analyses of trends in restoring and maintaining fire regimes in the Park's will also be performed. These will compare current trends in area burned to: 1) pre-Euroamerican trends in area burned annually and 2) change in trends over the last five years or some other time interval (see Caprio and Graber (1999) for details of analyses). Output would be either change in annual area burned or change in area within FRID category over the specified time interval.

Data Analysis

The parks' staff have developed an analysis called Fire Return Interval Departure (FRID) that compares pre- settlement fire regimes to recent regimes (a detailed discussion of the FRID analysis is provided in Chapter 4 of the Fire and Fuels Management Plan). Historic data used in this approach are estimates of fire return intervals (FRI) or maximum average fire return intervals. The FRI input is for a specific interval of time prior to Euroamerican settlement (1700 to 1860), the period prior to changes in vegetation structure/composition and fuels from grazing, changing ignition sources, and active fire suppression. The output provides maps that rank and highlight areas where fire return intervals have diverged the most from Euroamerican settlement conditions (Caprio et al. 1997; Keifer et al. 2000). The highlighted areas are those locations that have missed the greatest number of projected fire events, and thus are assumed to have the greatest ecological need for fire restoration.

Additional uses of this information are also possible. FRID output can be categorized to highlight locations that have undergone one or more restoration burns and are in need of an additional burn (either restoration of maintenance) due to the elapsed time since the last burn (Keifer et al. 1999). The current fire regime data and FRID analysis have also been used to evaluate the success of the fire management program over the last 30 years (Caprio and Graber 2000). Projections of the historic level of fire occurrence (area burned within each vegetation type) can be estimated from mean FRI. These values can then be compared against actual program achievements to provide feedback to the management program. This feedback can include whether the area burned annually needs to be increased or decreased, or whether different vegetation types need to be emphasized or de- emphasized when carrying out restoration or maintenance burns in locations where the natural role of fire must be restrained.

The season in which each fire burns will also be tracked to determine whether the seasonal aspect of fire regime is maintained in each vegetation type (Table 5).

Information Management

All field collections used to derive fire regime information are archived in the parks or at an approved location. They are primarily composed of partial cross- sections removed from logs, snags, or trees. Collections are currently housed in the Sycamore Lab Shed. All samples are labeled and cataloged in a database located on the fire history computer (office of the Fire Ecologist/Fire Research Coordinator) and backed up offsite. As a potential source of future reference information about fire in park ecosystems, these collections will have long- term value. Eventually, field evidence about past fire regimes will disappear, both because wood decomposes and through the impact of fire.

Specific sample site data and individual sample tree (sample catalog) data are maintained in database format ("**FH_GRP.DBF" and "**FHTREE.DBF" respectively where the '**' refers to a specific area, for example the East Fork of the Kaweah River is 'MK'). Associated site data (elevation, aspect, vegetation composition, fuel load) in the sample tree databases are periodically summarized ("ALL_SEKI_FH_SITES_VEGSUM") and available as either a database file (".DBF") or Arcview shapefile (".SHP") and an Arcview project ("FIREHIST_VEG_SUM.APR"). Hard copies of all field forms are also maintained in Room 4 of the old Fire Dorm.

Quality Control

An important component of the utilization of pre- Euroamerican fire regime information or fire history reconstructions is an evaluation of the quality of the information going into the estimates. This is especially important because the information has been derived from many sources and from a variety of locations. Some of these locations are at some distance outside the park, which may affect the applicability to park locations.

Caprio and Lineback (1997) reviewed and evaluated the current quality of fire regime information utilized in the parks' current fire regime monitoring methods using FRID. This ranking was based on a variety of criteria and essentially provided an estimate of confidence in the fire regime target condition values (see Table 4). Ranks varied from estimated (vegetation types where FRI values were estimated) to good. However, all estimates had at least some problems. For example, although many sites have reconstructed fire histories in a particular vegetation type, these sites may be limited to only a single aspect (for example, only south-facing slopes), which may limit their applicability across the whole landscape.

Responsible Party

The Fire Ecologist/Fire Research Coordinator is responsible for providing the most current baseline information used to compare with park fire regime maintenance efforts. The Fire GIS Technician is responsible for annually updating the appropriate GIS layers, in coordination with the Fire Management Office (FMO), and performing the analyses.

Funding

Current efforts to monitor FRI and season of fire occur using FIREPRO funded permanent staff and seasonal staff as requested.

Management Implications of Monitoring Results

Recent utilization of fire regime information has had several significant positive affects on the fire management program within the parks. Application of our current knowledge about FRI in specific vegetation types has provided target intervals of when subsequent burns need to be planned. The FRID analysis has resulted in significant changes in burn planning procedures by providing insight into areas that are most in need of having fire restored and in highlighting areas that have been burned previously but which need a second maintenance burn. Additionally, the information has provided an overall evaluation of how well the prescribed fire program is achieving objectives relative to process goals (see Caprio and Graber 2000). Lastly, as the quality and extent of our knowledge about past fire regimes improves, the value of this information to the fire management program will increase.

I. CULTURAL RESOURCES

All NPS units that implement wildland fire use and prescribed fire activities must develop short-term and long- term monitoring programs to assess accomplishments and to determine the effects of the associated management activities on park resources, including cultural resources.

As such, monitoring by way of "post- fire" inventories (ground surveys) of burned- over areas is a critical component of the parks' Fire Management Program. Key direction in designing and applying post- fire inventories is to be found in DO- 18 (Fire Management) and DO- 28 (Cultural Resource Management).

Monitoring Goal: Cultural resources monitoring provides information needed to determine the effects of fire management activities on cultural resources and to determine the effectiveness of site protection methods. Where feasible, increasing inventories of previously inaccessible areas is an additional goal.

Monitoring Objectives

1. Collect data sufficient to identify the effectiveness of pre- fire cultural resource surveys.

2. Undertake inventories of lands previously inaccessible due to dense brush and vegetation cover.

3. Record new survey results so as to increase the parks' inventory database, thus providing more comprehensive management and research information.

4. Use inventory results to promote compliance with Section 110 of the National Historic Preservation Act (i.e., direction to inventory all federal lands for the presence/absence of

cultural resources and to nominate to the National Register of Historic Places all properties that appear to qualify for listing).

Sampling Design

Cultural Resource Specialists will use their discretion and professional judgement, in consultation with the Fire Management Officer, to select specific acreage and methods for conducting post- fire inventories. Of consideration will be the particular features of the burned area or unit in question and the management benefit to cultural resources. In general, stratified, random surveys will be employed to maximize field efforts, with a goal of examining a minimum of 20 percent of pre- fire vegetated areas. Post- fire inventories may be designed to address any combination of the following focuses:

1. Previously inventoried acreage within a prescribed fire unit or wildland fire area as a cross-reference on the efficacy of the pre- fire methods and results.

2. Previously un- inventoried acreage within a prescribed fire unit or wildland fire area.

3. Sampling within identifiable vegetation zones or biotic communities to expand basic knowledge on site patterning and modeling.

4. Selective inventory of areas or features suspected to contain cultural resources but for which little or no data are available.

Field Measurements

Standard levels of recordation will be made for all post- fire inventories, including acres surveyed, survey intensity, and estimates of ground- surface visibility. Site forms (including maps, photographs, and illustrations) will be prepared for each newly recorded site/structure/feature. Isolated Find forms will be completed as appropriate. Updates to previously recorded sites will be completed as justified, with an emphasis on identifying newly exposed surface artifacts or features, expanded site dimensions, any apparent fire effects, and the like.

Timing of Monitoring

Post- fire survey should be undertaken within 60 days of the fire episode. Scheduling should consider the season (e.g., are rains imminent?), with an emphasis on targeting periods when ground visibility is maximized (e.g., before vegetation re- growth obscures ground surface visibility, or, after the first post- fire rain or wind episode sufficient to expose mineral soils).

Monitoring Site Location/Relocation

Cultural Resources Specialists, in consultation with the Fire Management Officer, will identify the location and limits of post- fire surveys. Knowledge of site patterning will be weighed against the effectiveness of the fire episode in exposing ground surfaces. Slopes in excess of 30 percent will generally not be included in the sample, unless specific conditions argue for their inclusion (e.g., caves and rock shelters exposed by the fire). Such areas excluded from examination will

not be used in calculating a 20 percent sample universe. Monitoring site locations will be plotted on field maps as part of the pre- field planning. GIS, GPS, and UTM data will be compared to assure the accurate placement of the monitoring sites and to assure that the selected sites are visited in the field.

Data Analysis

Post- fire data stand to enhance the parks' ability to better predict the potential impacts of a fire episode, whether during the planning stages of future prescribed fires or in response to a wildland fire. A report of results will be prepared for each post- fire cultural resource inventory. Minimally, such reports will be shared with the State Historic Preservation Officer, the Park Superintendent, and the Fire Management Officer.

Data Sheet Example

Results will be recorded on standard site forms, including Primary Records, Isolated Find forms, and attachments, as needed (DPR 523; State Historic Preservation Office 1990).

Information Management

Reporting requirements for cultural resource inventory projects can be found in NPS- 28. Further, key confidentiality rules apply to archeological and ethnographic resource information as identified in DO- 28.

Quality Control

Field personnel and principal investigators will meet the qualification standards found in Appendix E of NPS- 28.

Responsible Party

The parks' Cultural Resources Specialist is responsible for coordinating the design, implementation, and reporting of any post- fire inventory project. This individual will work closely with the parks' Fire Management Officer in meeting this requirement.

Funding

All expenditures (personnel, aircraft, equipment and supplies) for monitoring fire effects or the effectiveness of pre- fire protection treatments on cultural resources that are not covered by existing base accounts will be charged to the appropriate fire account. All expenditures will be tracked and reported according to the standards established in the Department of the Interior Individual Fire Occurrence Form (DOI- 1202). All fires will have an appropriate fire management accounting code (suppression, prescribed or fire use). Funding for post- fire inventories in previously unsurveyed areas will be sought on an annual basis from a number of sources.

Management Implications of Monitoring Results

Data recovered from the result of post- fire inventories stand to better inform future decisions when planning for prescribed fires or when responding to wildland fires. Increasing the intensity or focus of future inventories may result. Conversely, post- fire inventory data may prove useful in identifying areas or situations where the intensity or focus of cultural resource investigations can be lessened. Monitoring results should serve to increase the parks' effectiveness in meeting its responsibilities for the management of significant cultural resources.

J. FIRE MONITORING PROGRAM INTEGRATION

The above components of Sequoia and Kings Canyon National Parks' fire monitoring program were developed at different times in response to evolving fire management information needs. In addition, levels of funding for monitoring have varied throughout the program's history. As a result of differences in timing and levels of effort, the components are not as well integrated as they could be and vary in their scale of applicability.

The monitoring program began with environmental and fire conditions, and vegetation and fuels. These components provide information to guide fire management strategies and to assess project and stand- level objectives. Later, the parks' program took a step forward in the direction of large- scale restoration by embarking upon a project to test the feasibility of landscape- scale prescribed fire through treatment of an entire watershed within a relatively short period of time. With potential new issues arising from this larger- scale approach, the wildlife and water components were designed specifically to provide additional information for this watershed project.

While some of these monitoring efforts were focused in the East Fork Kaweah watershed, similar monitoring may be needed in other watersheds to determine whether results are more widely applicable throughout the parks. If this expansion occurs, the monitoring sites should be co- located with existing monitoring sites wherever possible to take advantage of the information provided by ongoing monitoring. Co- locating future monitoring with existing sites will provide more comprehensive information for those sites and result in a more integrated monitoring program.

In addition to a spatial expansion of the program, after several decades of an active prescribed fire program, restoration objectives were achieved in some areas and the need to define new, longer- term objectives arose. These objectives relating to maintaining the natural fire regime are applied both in areas where restoration is achieved and also areas that had not been greatly altered by fire exclusion. These new objectives focus on maintaining aspects of the fire regime that will perpetuate natural ecosystem processes, which in turn will influence future ecosystem component structure (e.g. fuel quantity and arrangement, wildlife habitat, vegetation composition, etc.). Refining the maintenance objectives and developing good measures for these objectives is the focus of the next phase of the fire monitoring program.

Since the development of the parks' fire monitoring program, the National Park Service has initiated a nationwide program to inventory and monitor natural resources (known as the Inventory and Monitoring, or I&M, Program) in parks grouped into 'networks' by eco- regions. Sequoia and Kings Canyon National Parks, is part of the Sierra Nevada Network, along with Yosemite National Park and Devils Postpile National Monument. The Sierra Nevada Network (SNN) has received I&M funding, has implemented inventory projects, and planning is underway for the development of an extensive, long- term monitoring program.

Key to the success of the fire monitoring program is continuing to maintain close ties with the SNN I&M program and with the research community. Results from the I&M program, as well as results from research conducted by the USGS Biological Resources Division, will provide additional useful information. This information, may offer excellent comparative capabilities, especially in areas where naturally- ignited and suppression fires occur, as well as areas where fire has been excluded for unusually long periods, making inferences from the monitoring results more powerful.

To ensure useful comparative analyses are possible, integration with the existing fire monitoring program is critical during the planning and implementation stages of the I&M program to ensure that the necessary information is collected in a useful and compatible way. The parks' fire monitoring program staff has been involved in scoping sessions to determine which of the parks' natural resource elements are most in need of long- term monitoring. Continued collaboration between the I&M and fire monitoring programs will help insure the most efficient use of both programs' funds and efforts, and provide for a more comprehensive and integrated long- term program to monitor the status of the parks' resources.

The various monitoring program staff should work together to take advantage of shared efforts where possible, reduce redundancy, and focus efforts on the highest priorities to provide the parks with the most efficient natural resource monitoring program. Continually identifying new information needs is essential to making sure that the parks are meeting fire- related resource goals as the fire management program evolves. Also, in response to new management objectives, the appropriate monitoring techniques must be developed and implemented.

K. REFERENCES

Caprio, A. C. and P. Lineback. 1997. Pre- twentieth century fire history of Sequoia and Kings Canyon National Parks: A review and evaluation of our knowledge. In: Proceedings of the Conference on Fire in California Ecosystems: Integrating Ecology, Prevention, and Management. Nov. 17- 20, 1997, San Diego, CA.

Caprio, A. C., C. Conover, M. Keifer, and P. Lineback. 1997. Fire management and GIS: A framework for identifying and prioritizing fire planning needs. In: Proceedings of the Conference on Fire in California Ecosystems: Integrating Ecology, Prevention, and Management. Nov. 17- 20, 1997, San Diego, CA.

Keeley, J. E. and N. L. Stephensen. 2000. Restoring natural fire regimes to the Sierra Nevada in an era of global change. Pages 255- 265 in Cole, D. N., and S. F. McCool, compilers. Wilderness Science in a Time of Change conference − Volume 5: Wilderness ecosystems, threats, and management; 1999 May 23- 27 Missoula MT. Proceedings RMRS- P- 15- Vol- 5. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Keifer, M., A.C. Caprio, P. Lineback, and K. Folger. 2000. Incorporating a GIS model of ecological need into fire management planning. In: Proceedings of the Joint Fire Science Conference and Workshop, Crossing the Millennium: Integrating Spatial Technologies and Ecological Principles for a New Age in Fire Management, June 14- 16, 1999, Boise, ID.

Keifer, M., N. L. Stephenson and J. Manley. 2000. Prescribed fire as the minimum tool for wilderness forest and fire restoration: a case study from the Sierra Nevada. In: Cole, David N.; McCool, Stephen F. Proceedings: Wilderness Science in a Time of Change. Proc. RMRS- P- 15. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Miller, C. and D.L. Urban. 1999. A model of surface fire, climate, and forest pattern in the Sierra Nevada, California. Ecological Modelling 114:113- 135.

National Park Service, U.S. Department of Interior. 2001. Fire Monitoring Handbook. National Interagency Fire Center, Boise, ID. 274 pp. http://www.nps.gov/fire/fmh/FEMHandbook.pdf.

National Park Service, U.S. Department of Interior. 1971. Sequoia and Kings Canyon National Parks Master Plan. Sequoia and Kings Canyon National Parks, Three Rivers, CA.

National Park Service. 1999. Natural and Cultural Resource Management Plan. Sequoia and Kings Canyon National Parks, Three Rivers, CA.

State Historic Preservation Office. 1990. Instructions for Completing the California Historic Resources Inventory Form (DPR 523). Sacramento, CA.

L. REVIEWERS

This plan was prepared by MaryBeth Keifer, Tony Caprio, Harold Werner, Corky Conover, and Tom Burge. The monitoring plan will be reviewed on an annual basis and revised if necessary.

This plan was reviewed by:

Bill Kaage, Fire Management Officer, Date
Sequoia and Kings Canyon National Parks

John Austin, Acting Chief, Division of Natural Resources, Date
Sequoia and Kings Canyon National Parks

Jeff Manley, Natural Resource Management Specialist, Sequoia and Kings Canyon National Parks — Date

Dave Graber, Science Advisor, Sequoia and Kings Canyon National Parks — Date

Paul Reeberg, Fire Effects Program Manager, NPS Pacific West Regional Office — Date

Robin Wills, Fire Ecologist, NPS Pacific West Regional Office — Date

M. ATTACHMENTS

Attachment 1 – Monitoring forms available.

Monitoring Program Component	Forms	Location of Forms
Environmental and fire conditions	Weather observation Fire behavior observation Smoke observation Fuel moisture summary Monitoring report outline Wildland fire observation summary	FMH, Appendix A (NPS 2001)
Vegetation and fuels	Park Monitoring Type Descriptions (FMH-4) modified FMH data sheets Field Data Checklist Quality Check Log	FMH, Appendix A (NPS 2001) SEKI LAN, j:\data\plants\fire_effects\vegetation_fuels_fmh\products\forms
Additional fuels information for modeling	Fuel data Stand data	SEKI LAN, j:\data\fire\fuels\gis
Wildlife	Plot data Serendipity data	SEKI LAN, j:\data\animals\vertebrates\wildlife_fire_effects\products

Attachment 2. Vegetation and Fuels Monitoring Type Descriptions

FMH-4 Monitoring Type Protocols FMH Data - SEKI Page: 0001
FMH version 3.10, Printed on 02/27/03, 5:58:14 pm

Current directory: C:\FMH

----------Description----------

Monitoring Type Code: FABCO1T08 Date Described: 06/15/00

Monitoring Type Name: White Fir-Mixed Conifer Forest

Preparer: M. Keifer, G. Dempsey

FGDC Association:

FMH-4 Version Title/Description: White fir-mixed conifer forest

Visits Assigned: 00 PR01, 00 PRE, 00 yr02, 00 yr04, 00 yr05, 00 yr10, 01 Post, 01 yr01, 01 yr02, 01 yr05, 01 yr10, 02 Burn, 02 Post, 02 yr01, 02 yr02, 02 yr05

Burn Prescription

Date of Burn (mo-mo).....08-01,11-30	Aspect (deg.).....000-000
Wind Direction (deg.).....	Spread Direction (B/H/F)..H
Fuel (tns/ac).....20.0-80.0	Herb Moisture (%).....0-0
Live Woody (tns/ac).....0.0-0.0	Midflame Wind (mph).....0.0-10.0
Herbs (tns/ac).....0.0-0.0	Rate of Spread (ch/hr)..0.0-8.0
Air Temp. (F).....40-85	Heat per Area (btu/ftý).165.0-225.0
Rel. Humidity (%).....20-60	Fireline Intns (btu/ftý)1.0-35.0
1-hr TLFM (%).....3-10	Slope (%).....0-60
10-hr TLFM (%).....11	Flame Length (ft).....0.0-2.5
100-hr TLFM (%).....12	Flame Zone Depth (ft)...0.0-0.0
1000-hr TLFM (%).....20	Scorch Height (m).....0.0-30.0
Woody Moisture (%).....0-0	Char Height (m).....0.0-0.0

Additional Prescription Information: Tons per acre were estimated.

Management Objectives: Reduce the total fuel load by 60-95% immediately postburn.

Monitoring Objectives: Measure the mean total fuel load with a sample size which will allow us to be 80% confident that our results are within 25% of the true population mean.

Objective Variables: Total fuel load (tons/acre); white fir overstory density

Physical Description: Predominately north and west aspects, though others may apply. Slopes range from 20-60% and are generally mid to upper slope. Elevation ranges from 4,100 - 7,200 feet. Soil depth ranges from shallow to very deep. Soils are generally rather coarse textured and acidic.

Current directory: C:\FMH

Biological Description: Of the total number of white firs (Abies concolor)present, roughly 25% or greater are mature overstory trees (>40cm at DBH). Sugar pine (Pinus lambertiana) and incense cedar (Calocedrus decurrens) will occur in varying amounts. At the higher elevations, associates may also include Jeffrey pine (Pinus jeffreyi) along w/ red fir (Abies magnifica). Overstory maturity rating is in the medium to high categories. Understory is usually comprised of incense cedar and white fir. There is a distinct absence of oaks of all species, and ponderosa pines (P. ponderosa) are rarely seen within the general vicinity. Total number of live trees within the 20m by 50m area will most likely range between 20 and 100 trees. Numerous trees fall into the intermediate and suppressed categories. The forest floor is typically sparse, with few herbs. Shrubs such as chinquapin (Chrysolepis sempervirens), hazelnut (Corylus cornuta), or Ribes sp. contribute <20% cover.

Rejection Criteria: Exclude riparian zones, anomalous vegetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20 meters of physical barriers such as roads or within 5 meters from any trail. Exclude areas where >25% of the overstory trees have been severely damaged by insects such as tussock moths.

Notes (This Entire Monitoring Type): See the notes listed under the FSEGI monitoring type for critical information.

----------General Protocols----------

Comments (Deviations, Problems, Omissions), this Version Only: (No information provided)

Preburn	Control Plots.....No	Herb. Height.....Yes
	Herbaceous Density.....No	Abbreviated Tags.....Yes
	0P/Origin Buried.....No	Herbaceous Fuel Load.....No
	Voucher Specimens.....Yes	Brush Fuel Load.....No
	Count Dead Branches of Living Plants as Dead.....No	
	Width "Observed" Transect..10.0m	
	Herb Transects Sampled.....Q4-Q1 Q3-Q2	
	Shrub Transects Sampled....Q4-Q1 Q3-Q2	
	Length One Shrub Transect..50m	Width One Shrub Transect...2.0m
	Total Shrub Area.....200.0m2	
	Stakes Installed At.....All 17	
Burn and Postburn	Duff Moisture.....Yes	Flame Zone Depth.....No
	100 Points Burn Severity...No	Herbaceous Fuel Load.....No
	Herb. (FMH-15/17/21).....Yes	

FMH version 3.10, Printed on 02/27/03, 5:58:14 pm

Current directory: C:\FMH

----------Forest Plot Protocols----------

```
Overstory Live Tree Damage...........Yes     Live Crown Position.........Yes
          Dead Tree Damage...........No      Dead Crown Position.........Yes
          Record DBH Year 1..........Yes
          Total Length Sample Area...100.0m  Total Width Sample Area.....10.0m
          Total Sample Area..........1000.00m2
          Quarters Sampled...........1 2 3 4
          Minimum allowed DBH........0.1cm   Maximum allowed DBH.........999.9cm

Pole-size Live Height................Yes     Poles Tagged................Yes
          Dead Height................Yes     Record DBH Year 1...........Yes
          Total Length Sample Area...25.0m   Total Width Sample Area.....10.0m
          Total Sample Area..........250.00m2
          Quarters Sampled...........1
          Minimum allowed DBH........2.5cm   Maximum allowed DBH.........15.0cm

Seedling  Live Height................Yes     Seedlings Mapped............Yes
          Dead Height................Yes     Dead Seedlings..............Yes
          Total Length Sample Area...10.0m   Total Width Sample Area.....5.0m
          Total Sample Area..........50.00m2
          Subsample of Quarter.......1

Fuel Load Number of Sampling Planes..4       1 HR Plane Length...........6ft
          10 HR Plane Length.........6ft     100 HR Plane Length.........12ft
          1000 HR Sound Plane Length.50ft    1000 HR Rotten Plane Length.50ft
          Calculate Dominance........Yes

Postburn  Overstory Char Height......Yes
          Pole-sized Postburn AssessmYes     Pole-sized Char Height......Yes
          Severity Transects Sampled.Fuel
```

Current directory: C:\FMH

----------Description----------

Monitoring Type Code: FABMA1T08 Date Described: 06/15/00

Monitoring Type Name: Red Fir Forest

Preparer: Keifer/Dempsey

FGDC Association:

FMH-4 Version Title/Description: Red fir forest

Visits Assigned: 00 PRE, 00 yr01, 00 yr02, 00 yr05, 01 Post, 01 yr01, 01 yr02, 01 yr05

Burn Prescription

Date of Burn (mo-mo).....	08-01,11-30	Aspect (deg.).....	0-90
Wind Direction (deg.).....		Spread Direction (B/H/F)..	H
Fuel (tns/ac).....	10.0-60.0	Herb Moisture (%).....	0-0
Live Woody (tns/ac).....	0.0-0.0	Midflame Wind (mph).....	0.0-10.0
Herbs (tns/ac).....	0.0-0.0	Rate of Spread (ch/hr)..	0.0-8.0
Air Temp. (F).....	40-85	Heat per Area (btu/ftý).	165.0-225.0
Rel. Humidity (%).....	20-60	Fireline Intns (btu/ftý)	1.0-35.0
1-hr TLFM (%).....	3-10	Slope (%).....	0-60
10-hr TLFM (%).....	11	Flame Length (ft).....	0.0-2.5
100-hr TLFM (%).....	12	Flame Zone Depth (ft)...	0.0-0.0
1000-hr TLFM (%).....	20	Scorch Height (m).....	0.0-30.0
Woody Moisture (%).....	0-0	Char Height (m).....	0.0-0.0

Additional Prescription Information: (No information provided)

Management Objectives: Reduce the total fuel load by 60-95% immediately postburn.

Monitoring Objectives: Measure the mean total fuel load with a sample size which will allow us to be 80% confident that our results are within 25% of the true population mean.

Objective Variables: Total fuel load (tons/acre); red fir overstory density.

Physical Description: Aspect is most commonly east and north slopes for pure stands of red fir. Slope varies from 0-60% and elevation ranges from 7,000 - 9,500 ft. Soils are often deep sandy loams associated with unglaciated areas, as well as shallower soils.

Current directory: C:\FMH

Biological Description: Overstory consists primarily of red fir (Abies magnifica), (>40% of the total of all trees present). At its lower limit, red fir is mixed with Jeffrey and sugar pine (Pinus jeffreyi and P. lambertiana) and incense cedar (Calocedrus decurrens). White fir (Abies concolor) individuals may also be present. Where white firs are more common, at least 80% of this species will be <40 cm at DBH, thus leaving the dominance of the stand to the red fir. Western white pine (Pinus monticola), lodgepole pine (Pinus contorta), montane brush and meadows are associated with red fir at its upper limit. Common understory vegetation includes manzanita (Arctostaphylos spp.), buckbrush (Ceanothus spp.), gooseberry (Ribes spp.) and chinquapin (Chrysolepsis sempervirens), however, keep in mind that the forest floor is generally much more open than in the lower elevation mixed conifer forests. Few herbaceous plants are present, especially at higher elevations.

Rejection Criteria: Exclude riparian zones, anomalous vegetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20 meters of physical barriers such as roads or within 5 meters from any trail.

Notes (This Entire Monitoring Type): Read all notes under the FSEGI monitoring type. (No old style plots apply for the FABMA monitoring type, however.)

----------General Protocols----------

Comments (Deviations, Problems, Omissions), this Version Only: See all notes under the FSEGI monitoring type.

Preburn	Control Plots	Yes	Herb. Height	Yes
	Herbaceous Density	No	Abbreviated Tags	Yes
	0P/Origin Buried	No	Herbaceous Fuel Load	No
	Voucher Specimens	Yes	Brush Fuel Load	No
	Count Dead Branches of Living Plants as Dead			No
	Width "Observed" Transect	10.0m		
	Herb Transects Sampled	Q4-Q1 Q3-Q2		
	Shrub Transects Sampled	Q4-Q1 Q3-Q2		
	Length One Shrub Transect	50m	Width One Shrub Transect	1.0m
	Total Shrub Area	100.0m2		
	Stakes Installed At	17		
Burn and Postburn	Duff Moisture	Yes	Flame Zone Depth	No
	100 Points Burn Severity	No	Herbaceous Fuel Load	No
	Herb. (FMH-15/17/21)	Yes		

FMH version 3.10, Printed on 02/27/03, 5:57:47 pm

Current directory: C:\FMH

----------Forest Plot Protocols----------

Overstory Live Tree Damage.....Yes Live Crown Position.....Yes
Dead Tree Damage.....Yes Dead Crown Position.....Yes
Record DBH Year 1.....Yes
Total Length Sample Area...50.0m Total Width Sample Area.....20.0m
Total Sample Area.....1000.00m2
Quarters Sampled.....1 2 3 4
Minimum allowed DBH.....0.0cm Maximum allowed DBH.....999.9cm

Pole-size Live Height.....No Poles Tagged.....No
Dead Height.....No Record DBH Year 1.....Yes
Total Length Sample Area...0.0m Total Width Sample Area.....0.0m
Total Sample Area.....0.00m2
Quarters Sampled.....1
Minimum allowed DBH.....0.0cm Maximum allowed DBH.....0.0cm

Seedling Live Height.....Yes Seedlings Mapped.....Yes
Dead Height.....Yes Dead Seedlings.....Yes
Total Length Sample Area...25.0m Total Width Sample Area.....10.0m
Total Sample Area.....250.00m2
Quarters Sampled.....1

Fuel Load Number of Sampling Planes..4 1 HR Plane Length.....6ft
10 HR Plane Length.....6ft 100 HR Plane Length.....12ft
1000 HR Sound Plane Length.50ft 1000 HR Rotten Plane Length.50ft
Calculate Dominance.....Yes

Postburn Overstory Char Height.....Yes
Pole-sized Postburn AssessmNo Pole-sized Char Height.....No
Severity Transects Sampled.Fuel

FMH version 3.10, Printed on 02/27/03, 5:59:39 pm

Current directory: C:\FMH

----------Description----------

Monitoring Type Code: BADFA1D04 Date Described: 08/17/00

Monitoring Type Name: Chamise Chaparral

Preparer: Keifer/Dempsey

FGDC Association:

FMH-4 Version Title/Description: Chamise chaparral

Visits Assigned: 00 PRE, 01 Post, 01 yr01, 01 yr02

Burn Prescription

Date of Burn (mo-mo)	09-01,02-15	Aspect (deg.)	140-270
Wind Direction (deg.)		Spread Direction (B/H/F)	H
Fuel (tns/ac)	0.0-0.0	Herb Moisture (%)	50-150
Live Woody (tns/ac)	0.0-0.0	Midflame Wind (mph)	0.0-8.0
Herbs (tns/ac)	0.0-0.0	Rate of Spread (ch/hr)	2.0-120.0
Air Temp. (F)	33-85	Heat per Area (btu/ftý)	1570.0-2910.0
Rel. Humidity (%)	20-60	Fireline Intns (btu/ftý)	50.0-6330.0
1-hr TLFM (%)	5-9	Slope (%)	0-60
10-hr TLFM (%)	10	Flame Length (ft)	3.0-25.0
100-hr TLFM (%)	11	Flame Zone Depth (ft)	0.0-0.0
1000-hr TLFM (%)	0	Scorch Height (m)	0.0-0.0
Woody Moisture (%)	0-0	Char Height (m)	0.0-0.0

Additional Prescription Information: (No information provided)

Management Objectives: Currently there are no specific objectives for this monitoring type. Generally speaking, the goal is to reduce hazardous amounts of fuel by lessening the % of cover of chaparral brush species while reintroducing fire to its natural role in the community.

Monitoring Objectives: % Cover of Brush.

Objective Variables: Measure the % cover of brush species with a sample size which will allow us to be 80% confident that our results are within 25% of the true population mean.

Physical Description: Generally found below 4,000 feet in elevation, on south and west facing slopes. Little soil is present on the dry, rocky, often steep slopes. May be interspersed with mixed chaparral and oak woodland forest.

Current directory: C:\FMH

Biological Description: Chaparral dominated by chamise (Adenostoma fasciculatum) 1-3m in height. Associated species contribute very little to cover. Mature stands are quite homogenous and are densely interwoven thus allowing very little opportunity for herbaceous plants to become established.

Rejection Criteria: Exclude riparian zones, anomalous vegetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20 meters of physical barriers such as roads or within 5 meters from any trail. Exclude areas >1/4 km from the roadway due to safety concerns and slopes over 60%.

Notes (This Entire Monitoring Type): (No information provided)

----------General Protocols----------

Comments (Deviations, Problems, Omissions), this Version Only: (No information provided)

Preburn	Control Plots	No	Herb. Height	Yes
	Herbaceous Density	No	Abbreviated Tags	Yes
	0P/Origin Buried	No	Herbaceous Fuel Load	No
	Voucher Specimens	Yes	Brush Fuel Load	No
	Count Dead Branches of Living Plants as Dead			No
	Width "Observed" Transect	0.0m		
	Herb Transects Sampled	0P-30P		
	Length One Shrub Transect	30m	Width One Shrub Transect	2.0m
	Total Shrub Area	60.0m2		
	Stakes Installed At	2		
Burn and Postburn	Duff Moisture	No	Flame Zone Depth	No
	100 Points Burn Severity	Yes	Herbaceous Fuel Load	No
	Herb. (FMH-15/17/21)	Yes		

FMH version 3.10, Printed on 02/27/03, 5:59:10 pm

Current directory: C:\FMH

----------Description----------

Monitoring Type Code: BARME1D04 Date Described: 08/17/00

Monitoring Type Name: Mixed Chaparral

Preparer: Keifer, Dempsey

FGDC Association:

FMH-4 Version Title/Description: Mixed chaparral

Visits Assigned: 00 PR01, 00 PRE, 01 Post, 01 yr01, 01 yr02, 01 yr05

Burn Prescription

Date of Burn (mo-mo).....	09-01,02-15	Aspect (deg.).....	
Wind Direction (deg.).....		Spread Direction (B/H/F)..	H
Fuel (tns/ac).....	0.0-0.0	Herb Moisture (%).....	50-150
Live Woody (tns/ac).....	0.0-0.0	Midflame Wind (mph).....	0.0-8.0
Herbs (tns/ac).....	0.0-0.0	Rate of Spread (ch/hr)..	2.0-120.0
Air Temp. (F).....	33-85	Heat per Area (btu/ftý).	1570.0-2910.0
Rel. Humidity (%).....	20-60	Fireline Intns (btu/ftý)	50.0-6330.0
1-hr TLFM (%).....	5-9	Slope (%).....	0-60
10-hr TLFM (%).....	10	Flame Length (ft).....	3.0-25.0
100-hr TLFM (%).....	11	Flame Zone Depth (ft)...	0.0-0.0
1000-hr TLFM (%).....	0	Scorch Height (m).....	0.0-0.0
Woody Moisture (%).....	0-0	Char Height (m).....	0.0-0.0

Additional Prescription Information: (No information provided)

Management Objectives: No objective has been identified at this time. Our current goal is to reduce brush cover by restoring fire.

Monitoring Objectives: Measure the % cover of brush species with a sample size which will allow us to be 80% confident that our results are within 25% of the true population mean.

Objective Variables: % cover of brush speice

Physical Description: Found below 5,000 feet on dry, rocky slopes with little soil. Slopes range from 0-60% and may be fund within a variety of aspects. Substrate is commonly rockky and dry.

Current directory: C:\FMH

Biological Description: Drought tolerant, sclerophyllous shrubs, 2-4m in height form dense, often impenetrable walls of vegetation which are dominated by mountain whitethorn (Ceanothus cuneatus), Fremontia (Fremontodendron californicum), manzanita (Arctostaphylos kelloggii) and mountain mohogany (Cercocarpus betuloides). Other understory brush associates may include varying amounts of buckeye (Aesculus californica), coffeeberry (Rhamnus spp.) and poison oak (Toxicodendron diversilobum). Herbaceous plants (Bromus spp., Avena spp., Vulpia spp., Cryptantha spp., Phacelia spp., Claytonia spp., and Galium spp.) can be uncommon, with diversity increasing during the first few years following fire. Where herbaceous cover is sparse, a layer of leaf litter may have accumulated.

Rejection Criteria: Exclude riparian zones, anomalous vegetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20m of physical barriers such as roads or w/in 5 m from any trail. Exclude areas >1/4 km from the road, due to safety concerns as well as slopes over 60%.

Notes (This Entire Monitoring Type): Notes: % cover is picked up from the OP-30P line. It has been determined that density of individual brush species will not be sampled as it does not relate to any current objectives and poses sampling difficulties. Additional plants are examined (and recorded) in a 5m wide belt along either side of the OP-30P line.

Small tree like shrubs (examples: manzanita, buckbrush, Quercus kelloggii and Fremontia) are found within some of these plots. Because they are growing more like shrubs than trees, we are recording their height to the nearest decimeter even if they go past 2.0 meters.

Current directory: C:\FMH

----------General Protocols----------

Comments (Deviations, Problems, Omissions), this Version Only: (No information provided)

Preburn	Control Plots	No	Herb. Height	Yes
	Herbaceous Density	No	Abbreviated Tags	Yes
	0P/Origin Buried	No	Herbaceous Fuel Load	No
	Voucher Specimens	Yes	Brush Fuel Load	No
	Count Dead Branches of Living Plants as Dead			No
	Width "Observed" Transect	0.0m		
	Herb Transects Sampled	0P-30P		
	Length One Shrub Transect	30m	Width One Shrub Transect	1.0m
	Total Shrub Area	30.0m2		
	Stakes Installed At	2		
Burn and Postburn	Duff Moisture	No	Flame Zone Depth	No
	100 Points Burn Severity	No	Herbaceous Fuel Load	No
	Herb. (FMH-15/17/21)	No		

FMH version 3.10, Printed on 02/27/03, 5:57:22 pm

Current directory: C:\FMH

----------Description----------

Monitoring Type Code: FCADE1T09 Date Described: 06/15/00

Monitoring Type Name: Low Elevation-Mixed Conifer

Preparer: Keifer and Dempsey

FGDC Association:

FMH-4 Version Title/Description: Low elevation-mixed conifer forest

Visits Assigned: 00 PR01, 00 PR02, 00 PRE, 00 yr02, 01 Post, 01 yr01, 01 yr02, 01 yr05, 01 yr10

Burn Prescription

Date of Burn (mo-mo)	07-15,11-30	Aspect (deg.)	180-270
Wind Direction (deg.)		Spread Direction (B/H/F)	H
Fuel (tns/ac)	10.0-60.0	Herb Moisture (%)	0-0
Live Woody (tns/ac)	0.0-0.0	Midflame Wind (mph)	0.0-8.0
Herbs (tns/ac)	0.0-0.0	Rate of Spread (ch/hr)	1.0-18.0
Air Temp. (F)	40-85	Heat per Area (btu/ftý)	320.0-390.0
Rel. Humidity (%)	20-60	Fireline Intns (btu/ftý)	4.0-120.0
1-hr TLFM (%)	5-7	Slope (%)	0-45
10-hr TLFM (%)	8	Flame Length (ft)	1.0-4.0
100-hr TLFM (%)	9	Flame Zone Depth (ft)	0.0-0.0
1000-hr TLFM (%)	20	Scorch Height (m)	0.0-30.0
Woody Moisture (%)	0-0	Char Height (m)	0.0-0.0

Additional Prescription Information: (No information provided)

Management Objectives: Reduce the total fuel load by 60-95% immediately postburn.

Monitoring Objectives: Measure the mean total fuel load with a sample size which wil allow us to be 80% confident that our results are within 25% of the true population mean.

Objective Variables: Total fuel load (tons/acre); incense cedar overstory density

Physical Description: Aspect is south or west but can vary widely. Slopes range from 0-60%, and are mid to lower slope. Elevation begins at 4,500 ft and extends to 6,000 ft. Soils are often but now always thin, and barren rock outcrops are common.

Current directory: C:\FMH

Biological Description: Overstory consists of incense cedar (Calocedrus decurrens), often near 1/3 of the area, along with varying amounts of sugar pine (Pinus lambertiana), black oak (Quercus kelloggii) and canyon live oak (Q. chrysolepsis). Ponderosa pine does not comprise more than 15% of the overstory, and Jeffrey pine individuals are rarely found in the general area. Mature white fir (>40 cm dbh) comprise less than 10% of the overstory. Overstory maturity rating is in the low to medium range, with many trees falling into the intermediate and suppressed categories. Understory is usually comprised of incense cedar, various oaks and white fir. Total number of live trees usually ranges between 60 and 200 per 20m by 50m area, making these forests typically more dense than those found within the FABCO monitoring type. Shrubs such as manzanita (Arctostaphylos spp.), buckbrush (Ceanothus spp.), gooseberry (Ribes spp.), Rubus spp., Prunus spp., or bear clover (Chamaebatia foliolosa) compose a larger portion of the understory than in higher elevation forests. Herbs are sparse to moderately common.

Rejection Criteria: Exclude riparian zones, anomalous vegetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20 meters of physical barriers such as roads or within 5 meters from any trail. Exclude areas where >25% of the overstory trees have been severely damaged by insects such as tussock moths.

Notes (This Entire Monitoring Type): Read all notes under the FSEGI monitoring type for all deviations from the FMH protocol.

----------General Protocols----------

Comments (Deviations, Problems, Omissions), this Version Only: (No information provided)

Preburn	Control Plots.....Yes	Herb. Height.....Yes	
	Herbaceous Density.....No	Abbreviated Tags.....Yes	
	0P/Origin Buried.....No	Herbaceous Fuel Load.....No	
	Voucher Specimens.....Yes	Brush Fuel Load.....No	
	Count Dead Branches of Living Plants as Dead.....No		
	Width "Observed" Transect..10.0m		
	Herb Transects Sampled.....Q4-Q1 Q3-Q2		
	Shrub Transects Sampled....Q4-Q1 Q3-Q2		
	Length One Shrub Transect..50m	Width One Shrub Transect...2.0m	
	Total Shrub Area.....200.0m2		
	Stakes Installed At.....All 17		
Burn and Postburn	Duff Moisture.....Yes	Flame Zone Depth.....No	
	100 Points Burn Severity...No	Herbaceous Fuel Load.....No	
	Herb. (FMH-15/17/21).....Yes		

FMH version 3.10, Printed on 02/27/03, 5:57:22 pm

Current directory: C:\FMH

----------Forest Plot Protocols----------

Overstory	Live Tree Damage	Yes	Live Crown Position	Yes
	Dead Tree Damage	No	Dead Crown Position	Yes
	Record DBH Year 1	Yes		
	Total Length Sample Area	50.0m	Total Width Sample Area	20.0m
	Total Sample Area	1000.00m2		
	Quarters Sampled	1 2 3 4		
	Minimum allowed DBH	0.0cm	Maximum allowed DBH	999.9cm
Pole-size	Live Height	Yes	Poles Tagged	Yes
	Dead Height	Yes	Record DBH Year 1	Yes
	Total Length Sample Area	25.0m	Total Width Sample Area	10.0m
	Total Sample Area	250.00m2		
	Quarters Sampled	1		
	Minimum allowed DBH	2.5cm	Maximum allowed DBH	15.0cm
Seedling	Live Height	Yes	Seedlings Mapped	Yes
	Dead Height	Yes	Dead Seedlings	Yes
	Total Length Sample Area	10.0m	Total Width Sample Area	5.0m
	Total Sample Area	50.00m2		
	Subsample of Quarter	1		
Fuel Load	Number of Sampling Planes	4	1 HR Plane Length	6ft
	10 HR Plane Length	6ft	100 HR Plane Length	12ft
	1000 HR Sound Plane Length	50ft	1000 HR Rotten Plane Length	50ft
	Calculate Dominance	Yes		
Postburn	Overstory Char Height	Yes		
	Pole-sized Postburn Assessm	Yes	Pole-sized Char Height	Yes
	Severity Transects Sampled	Fuel		

FMH version 3.10, Printed on 02/27/03, 5:56:54 pm

Current directory: C:\FMH

----------Description----------

Monitoring Type Code: FPIPO1T09 Date Described: 06/15/00

Monitoring Type Name: Ponderosa Dominated Forest

Preparer: Haggerty/Keifer/Dempsey

FGDC Association:

FMH-4 Version Title/Description: Ponderosa pine dominated forest

Visits Assigned: 00 PR01, 00 PRE, 00 yr01, 00 yr02, 00 yr04, 00 yr05, 00 yr10, 01 Post, 01 yr01, 01 yr02, 01 yr03, 01 yr05, 02 Post, 02 yr01, 02 yr02

Burn Prescription

Date of Burn (mo-mo).....07-15,11-30	Aspect (deg.).....0-0
Wind Direction (deg.).....	Spread Direction (B/H/F)..H
Fuel (tns/ac).....0.0-0.0	Herb Moisture (%).....0-0
Live Woody (tns/ac).....0.0-0.0	Midflame Wind (mph).....0.0-8.0
Herbs (tns/ac).....0.0-0.0	Rate of Spread (ch/hr)..1.0-18.0
Air Temp. (F).....40-85	Heat per Area (btu/ftý).320.0-390.0
Rel. Humidity (%).....20-60	Fireline Intns (btu/ftý)4.0-120.0
1-hr TLFM (%).....5-7	Slope (%).....0-45
10-hr TLFM (%).....8	Flame Length (ft).....1.0-4.0
100-hr TLFM (%).....9	Flame Zone Depth (ft)...0.0-0.0
1000-hr TLFM (%).....20	Scorch Height (m).....0.0-30.0
Woody Moisture (%).....0-0	Char Height (m).....0.0-0.0

Additional Prescription Information: (No information provided)

Management Objectives: Reduce the total fuel load by 60-95% immediately postburn.

Monitoring Objectives: Measure the mean total fuel load with a sample size which will allow us to be 80% confident that our results are within 25% of the true population mean.

Objective Variables: Total fuel load (tons/acre); incense cedar overstory density.

Physical Description: Aspect is south, west, or flat as in canyon bottoms. Slopes range from 0-30%. Elevation begins at 4,500 with the lower and upper boundaries dependent on aspect. Soils are often but not always thin, and barren rock outcrops are common.

Current directory: C:\FMH

Biological Description: Overstory consists of at least 15% ponderosa pine (Pinus ponderosa), but often ranges to nearly complete dominance of the plot area. Incense cedar (Calocedrus decurrens), black oak (quercus kelloggii) and canyon live oak (Q. chrysolepis) are present in varying degrees. Overstory maturity rating is in the medium to high categories. Understory is usually comprised of incense cedar, black oak and canyon live oak. Shrubs such as manzanita (Arctostphylos spp.), buckbrush (Ceanothus spp.), gooseberry (Ribes spp.), Rubus spp., Prunus spp., Eriogonum spp., or bear clover (Chamaebatia foliolosa) compose a larger portion of the understory than in higher elevation forests. Herbs are sparse to moderately common.

Rejection Criteria: Exclude riparian zones, anomalous vegetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20 meters of physical barriers such as roads or within 5 meters from any trail. Exclude areas where >25% of the overstory trees have been severely damaged by insects such as tussock moths.

Notes (This Entire Monitoring Type): Monitoring Type Notes, CRITICAL!: Read all the notes under the FSEGI monitoring type.

----------General Protocols----------

Comments (Deviations, Problems, Omissions), this Version Only: (No information provided)

Preburn	Control Plots	Yes	Herb. Height	Yes
	Herbaceous Density	No	Abbreviated Tags	Yes
	0P/Origin Buried	No	Herbaceous Fuel Load	No
	Voucher Specimens	Yes	Brush Fuel Load	No
	Count Dead Branches of Living Plants as Dead			No
	Width "Observed" Transect	10.0m		
	Herb Transects Sampled	Q4-Q1 Q3-Q2		
	Shrub Transects Sampled	Q4-Q1 Q3-Q2		
	Length One Shrub Transect	50m	Width One Shrub Transect	1.0m
	Total Shrub Area	100.0m2		
	Stakes Installed At	17		
Burn and Postburn	Duff Moisture	Yes	Flame Zone Depth	No
	100 Points Burn Severity	No	Herbaceous Fuel Load	No
	Herb. (FMH-15/17/21)	Yes		

FMH version 3.10, Printed on 02/27/03, 5:56:54 pm

Current directory: C:\FMH

----------Forest Plot Protocols----------

```
Overstory Live Tree Damage...........Yes     Live Crown Position.........Yes
          Dead Tree Damage...........No      Dead Crown Position.........Yes
          Record DBH Year 1..........Yes
          Total Length Sample Area...50.0m   Total Width Sample Area.....20.0m
          Total Sample Area..........1000.00m2
          Quarters Sampled...........1 2 3 4
          Minimum allowed DBH........0.0cm   Maximum allowed DBH.........999.9cm

Pole-size Live Height................Yes     Poles Tagged................Yes
          Dead Height................Yes     Record DBH Year 1...........Yes
          Total Length Sample Area...0.0m    Total Width Sample Area.....0.0m
          Total Sample Area..........0.00m2
          Quarters Sampled...........1
          Minimum allowed DBH........2.5cm   Maximum allowed DBH.........15.0cm

Seedling  Live Height................Yes     Seedlings Mapped............Yes
          Dead Height................Yes     Dead Seedlings..............Yes
          Total Length Sample Area...25.0m   Total Width Sample Area.....10.0m
          Total Sample Area..........250.00m2
          Quarters Sampled...........1

Fuel Load Number of Sampling Planes..4       1 HR Plane Length...........6ft
          10 HR Plane Length.........6ft     100 HR Plane Length.........12ft
          1000 HR Sound Plane Length.50ft    1000 HR Rotten Plane Length.50ft
          Calculate Dominance........Yes

Postburn  Overstory Char Height......Yes
          Pole-sized Postburn AssessmNo      Pole-sized Char Height......No
          Severity Transects Sampled.Fuel
```

Current directory: C:\FMH

----------Description----------

Monitoring Type Code: FSEGI1T08 Date Described: 06/15/00

Monitoring Type Name: Giant sequoia-mixed conifer

Preparer: Haggerty/Keifer/Dempsey

FGDC Association:

FMH-4 Version Title/Description: Giant sequoia-mixed conifer forest

Visits Assigned: 00 PR01, 00 PR02, 00 PRE, 00 Post, 00 yr02, 00 yr04, 00 yr05, 00 yr10, 00 yr20, 01 Post, 01 yr01, 01 yr02, 01 yr03, 01 yr04, 01 yr05, 01 yr08, 01 yr10, 01 yr12, 01 yr99, 02 Post, 02 yr01, 02 yr02, 02 yr05, 02 yr10, 02 yr20, 02 yr99

Burn Prescription

Date of Burn (mo-mo).....07-15,11-30	Aspect (deg.).....1-359
Wind Direction (deg.).....0-359	Spread Direction (B/H/F)..H
Fuel (tns/ac).....35.0-100.0	Herb Moisture (%).....0-0
Live Woody (tns/ac).....0.0-0.0	Midflame Wind (mph).....0.0-10.0
Herbs (tns/ac).....0.0-0.0	Rate of Spread (ch/hr)..0.0-8.0
Air Temp. (F).....40-85	Heat per Area (btu/ftý).165.0-225.0
Rel. Humidity (%).....20-60	Fireline Intns (btu/ftý)1.0-35.0
1-hr TLFM (%).....3-10	Slope (%).....0-60
10-hr TLFM (%).....11	Flame Length (ft).....0.0-2.5
100-hr TLFM (%).....12	Flame Zone Depth (ft)...0.0-0.0
1000-hr TLFM (%).....20	Scorch Height (m).....0.0-30.0
Woody Moisture (%).....0-0	Char Height (m).....0.0-0.0

Additional Prescription Information: (No information provided)

Management Objectives: Reduce the total fuel load by 60-95% immediately postburn. Reduce the total tree density to 50-250 trees/hectare for trees <80 cm DBH and 10-75 trees/hectare for trees >80 cm DBH.

Monitoring Objectives: Measure mean total fuel reduction with a sample size that will allow for 80% confidence in detecting a 40% change in fuel load and accepting a 20% chance of detecting a change that does not truly occur. Measure mean total tree density for trees <80 cm DBH and trees >80 cm DBH with a sample size that will allow for 80% confidence that the results are within 25% of the true population mean.

Current directory: C:\FMH

Objective Variables: Total fuel load (tons/acre); Total tree density by diameter class (trees/hectare)

Physical Description: All aspects. Slopes 20-60%, in drainage bottoms or broad upland basins, or occasionally steep slopes and ridgetops. Elevation from 5,500-8,000 feet. Soil depth ranges from shallow to very deep. Soils are generally rather coarse textured and acidic.

Biological Description: Overstory consists of mature white fir (Abies concolor), sugar pine (Pinus lambertiana), ponderosa pine (P. ponderosa), incense cedar (Calocedrus decurrens) and giant sequoia (Sequoiadendron giganteum). Due to the extreme size of the sequoia trees it is possible that no big trees will fall w/in the 20m by 50m plot area, however, mature trees should at least be within seed rain of the plot location. Overstory maturity is in the medium to high categories. Understory is usually comprised of incense cedar and white fir with occasional black oak (Quercus kelloggii). The forest floor is typically sparse, with few herbs. Shrubs such as chinquapin (Chrysolepis sempervirens), or hazelnut (Corylus cornuta) contribute <20% cover.

Rejection Criteria: Exclude riparian zones, anomalous vetetation patches, monitoring type boundaries, large rock outcroppings or barren areas (>20% of the plot), or areas within 20 meters of physical barriers such as roads or within 5 meters from any trail (exception for very small units). Exclude plots beyond the seed rain of giant sequoias.

Notes (This Entire Monitoring Type): Monitoring Type Notes: Critical! Some of the initial plots installed in this monitoring type were read according to a set of protocol that were in place prior to the implementation of the FMH handbook. These older protocol will affect any FSEGI plots found from numbers 1-57. To determine if a plot is being monitored using these older methods, look for the SEKI-RMO Shurb/Major Herb, SEKI-RMO Tagged Tree form. If the forms are present prior to the last visit, but not within the most recent visit, the plots have already been converted to the FMH protocol. If, however, these forms are located in the last visit, you will need to read these plots in the following manner:
VEGETATION: The % of cover for plants is determined by starting at the OP end of the centerline tape and working towards the 50P end. All substrate materials (rock, wood, bole, bare) or plants are recorded if they occupy at least 5 cm worth of space along the center line. If, for example, litter is the substance at the beginning of the tape and it stretches until 1.03m along the tape, that is what gets recorded. Then, from 1.03m to 1.08m a rock may be found. If a plant, rock or other material bisects the top of the tape (transect plane) but occupies less than 5 cm worth of space, it is ignored and the primary substance that is present gets recorded instead. For example, if litter stretches from 0.00 to 1.03m, followed by a plant that covers from 1.03m to 1.04m, the older method would state that litter stretched from 0.00m to 1.04m. Hence, you will find that there is no break in the sequence of numbers being listed in the start-end-start columns. "Start" is where the tape measurement begins for each substance. "End" is the stopping point of the tape for that same item. "Dist"

Current directory: C:\FMH

is the distance encompassed by the object.
Note: 1. For SEKI's purpose, on the veg line for both old and new style plots, wood is defined as a chunk of material that is over 3.0 inches in diamter. Otherwise, smaller pieces of wood get recorded as litter. 2. Though not required by the FMH, SEKI has determined that it will reread the veg lines during postfire visits in order to determine changes in the %cover. 3. When old style plots reach the "reburn" status, the veg line is read both the old style way (described above) as well as according to the new FMH style as outlined in the book.
SEEDLINGS: Whether the FPIPO plots are being read old or new (FMH) style, seedlings should be done in the following manner. (Please note the differences between these protocol and those listed in the FMH. They are intended to increase our accuracy when seedling density is extreme, as well as to make the seedling maps more helpful, time efficient and accurate.)
SIZE CLASS 1: Never map these! Check in the folder to determine what area was sampled previously for SIZE CLASS 1. If it appears that the density is such that we can sample the same area, let's do so. If the previous sample size was very limited due to high density, and this density now appears to be greatly reduced, enlarge the sample area to the largest portion of Q1 that can reasonably be counted. (The reverse is also true. If the whole quarter was done previously but the density is astronomical now, we can lower the sample size.) Recommendations: If there are more than 300 seedlings in all of Q1, sample the 5 x 10m area proximal to the P1 line. If there are more than 300 seedlings in the 5 x 10, sample the four 1 meter square corners of Q1. By starting your count in the 5x10 you could save yourself a great deal of time should the densities prove to be higher than you originally estimated. Use the information on the modified FMH-14 data sheet to multiply out the subsample that was chosen. Enter your final number into the computer.
SIZE CLASS 2 and GREATER SEEDLINGS: Map and count all class 2 and greater seedling throughout the entire quarter, no matter what their density levels are, even if class 1 seedlings were only counted in the 4 corners! Remember, class 2 and above seedling need to be mapped on a FMH-16. No multiplication factors will be necessary for class 2 seedlings and above because they are always sampled throughout all of quarter 1.
Trees: (both old ((roughly #'s 1-57)) and new style plots ((#57+)): The same basic information has been gathered on trees since the inception of SEKI's program. To make data collection smoother, data is recorded on the FMH-8 form rather than the old SEKI-RMO form for Tagged Trees. The only deviation from FMH protocol is that we do not recognize pole-sized trees in the same manner. At SEKI, any tree over 1.37 m is considered to be part of the overstory despite what its diameter is. The FMH computer program states that our poles are >2.5 cm but <15.0. This is not true, and the DBASE program we use to analyze trees allows us to identify trees by any size class parameters we desire which is important because some of our "poles" have diameters <2.5 cm. (The FMH software does not allow for flexibility in this matter, so the true differences are noted here for posterity's sake.) These smaller trees are still tagged (at DBH if possible, if not, look for a tag at the base) and are included when considering CPC codes. Hence, code 4 trees are generally quite small.
For FSEGI plots numbered 93+, 12 extra 10 x 25 m quarters were sampled for overstory SEGI trees. The schematic for the layout of these quaters is diamgrammed on the direction sheet for plot 93 but it should be noted, that due to the obviousness of these huge trees, no extra rebar or tree tags were put in place to permanently mark this sampling area. Trees that show up w/ quater

numbers 5-16 are for our information but do not get entered into the FMH software. Note: The sampling area was enlarged so that more SEGI trees would be captured. Due to their enormous size, a 20m x 50m plot may contain only 1 tree or even less of this species.
BRUSH DENSITY: In the past, brush density was conducted by guessing at what a individual was, or by counting clumps. Repeating these estimates proved to be futile. Hence, in 1997, we modified the brush protocol to fit local vegetation. Density numbers prior to this time should not be used for puroses of analyses. The modified FMH-18 (which is evidence of when each plot underwent the protocl change) should be used on all FABCO plots, whether they are old or new style. Primary differences between this methodolgy and those listed in the FMH include:
1. Rather than guessing an individual, individual counts are done only when a single plant can truly be identified such as in the case of Cercocarpus, Fremontia and certain species of Arctostaphylos and Quercus.
2. Stem counts (whcih are not entered into the computer) will be conducted for brush species where telling the individual is not practical. (Examples: Chrysolepsis, Ribes, Adenostoma, Symphoricarpus and some species of Arctostaphylos and Quercus.)
3. Brush that is not practical to count by methods 1 or 2 will be picked up on the veg line only via %cover. Examples: Ceanothus, Prunus emarginata and Chamaebatia foliolosa.
For those Genera which have variable growth forms (Quercus, Arctostaphylos) it will be necessary to check the previous data sheet to determine which method was used. If species other than those listed above are found on a plot, a determination wil be made in the field as to which method should be used. Note: Pre and post fire growth forms were taken into account in developing these protocol.
FUELS: 4 Brown's transects are read on each plot according to protocol described in the FMH and Brown's handbook. Strange exceptions are outlined in the strange plot questions folder in the grey file cabinet in the back room (the one w/ the air conditioner.)
PHOTOS: Photos, where possible, are taken in the following manner using asa 200 speed Ektachrome slide film. Kneel on 1 knee, 10 ft. from the appropriate stake and take a Vertical picture. 8 photos are also taken of the Brown's lines wherein F F1-0 is Fuel transect 1, standing at the centerline. F1-50 is fuel transect 1, standing at the 50 ft. end, looking back at the centerline. Repeat photo: Starting in 1998, 1 photo was taken of each plot from the best location to get an overall view of the plot. Directions on how and where this was taken can be found on the photo sheets or on the white tab on the inside flap of each folder's brown manilla jacket. When regular plot stakes were not used, 2 green stakes were used to mark the photo location. Tags on these will state: "Place clipboard here" and "stand here" so as to lessen confusion.
RED FLAG PLOT WARNINGS: Some of the earliest plots had some design error that was discovered upon subsequent visits (wrong size...so it was resized, Brown's lines run backwards etc). When a problem like this was identified, it was typed up on a sheet called the "Red Flag Warning" and inserted into the folder w/ a note on the plot cover, alerting you to the potential pitfall that lurks within. How the problem was resolved is also included so it is worth your time to thoroughly read over these notes before proceeding.

FMH version 3.10, Printed on 02/27/03, 5:55:54 pm

Current directory: C:\FMH

----------General Protocols----------

Comments (Deviations, Problems, Omissions), this Version Only: (No information provided)

Preburn	Control Plots	Yes	Herb. Height	Yes
	Herbaceous Density	No	Abbreviated Tags	Yes
	0P/Origin Buried	No	Herbaceous Fuel Load	No
	Voucher Specimens	Yes	Brush Fuel Load	No
	Count Dead Branches of Living Plants as Dead			No
	Width "Observed" Transect	10.0m		
	Herb Transects Sampled	Q4-Q1 Q3-Q2		
	Shrub Transects Sampled	Q4-Q1 Q3-Q2		
	Length One Shrub Transect	50m	Width One Shrub Transect	1.0m
	Total Shrub Area	100.0m2		
	Stakes Installed At	All 17		
Burn and Postburn	Duff Moisture	Yes	Flame Zone Depth	Yes
	100 Points Burn Severity	No	Herbaceous Fuel Load	No
	Herb. (FMH-15/17/21)	Yes		

----------Forest Plot Protocols----------

Overstory	Live Tree Damage	Yes	Live Crown Position	Yes
	Dead Tree Damage	No	Dead Crown Position	Yes
	Record DBH Year 1	Yes		
	Total Length Sample Area	50.0m	Total Width Sample Area	20.0m
	Total Sample Area	1000.00m2		
	Quarters Sampled	1 2 3 4		
	Minimum allowed DBH	0.1cm	Maximum allowed DBH	999.9cm
Pole-size	Live Height	No	Poles Tagged	No
	Dead Height	No	Record DBH Year 1	No
	Total Length Sample Area	0.0m	Total Width Sample Area	0.0m
	Total Sample Area	0.00m2		
	Quarters Sampled	1		
	Minimum allowed DBH	2.5cm	Maximum allowed DBH	15.0cm
Seedling	Live Height	Yes	Seedlings Mapped	Yes
	Dead Height	Yes	Dead Seedlings	Yes
	Total Length Sample Area	25.0m	Total Width Sample Area	10.0m
	Total Sample Area	250.00m2		
	Quarters Sampled	1		
Fuel Load	Number of Sampling Planes	4	1 HR Plane Length	6ft
	10 HR Plane Length	6ft	100 HR Plane Length	12ft
	1000 HR Sound Plane Length	50ft	1000 HR Rotten Plane Length	50ft
	Calculate Dominance	Yes		
Postburn	Overstory Char Height	Yes		

Current directory: C:\FMH

Pole-sized Postburn AssessmNo Pole-sized Char Height......Yes
Severity Transects Sampled.Fuel

D - Fire and Fuels Research Plan

Natural science research is and will continue to be an important activity in these parks. It serves two primary purposes in relation to the fire and fuels management program. First, it helps to define both natural fire regimes as well as the range of natural conditions that serve as ecological foundations for the application of fire in park ecosystems. Second, it is used as a tool to evaluate actions used to restore and/or perpetuate desired conditions as contemplated in the policies for management of natural areas in the NPS. This research can have either tactical or strategic applications. Such research will continue to be encouraged and supported in an effort to further improve the parks' fire and fuels management program.

Considerable fire research has been carried out in Sequoia and Kings Canyon National Parks over the past several decades. This has included a variety of studies in sequoia- mixed conifer forests (Kilgore 1972, Kilgore and Taylor 1979, Parsons and DeBenedetti 1979, Harvey and others 1980, Stephenson and others 1991; Swetnam and others 1992, 1998; Swetnam 1993; Mutch 1994; Caprio and Swetnam 1995; Stephenson 1994; Miller and Urban 1999, 2000), low elevation foothill communities (Rundel and Parsons 1979, Parsons 1981, Rundel and others 1987), and high elevation forests and meadows (Vankat 1970; Kilgore 1971, DeBenedetti and Parsons 1984; Pitcher 1981, 1987).

These studies have provided a firm justification and basis for the development of the parks' prescribed and natural fire management programs (Bancroft and others 1985). While much is known from these studies, in most cases they have not provided the full level of detail necessary to completely understand natural fire regimes or the effects of variable intensity fires on subtle ecosystem properties.

Research needs and priorities are jointly identified by the Division of Natural Resources and the USGS Southern Sierra Field Station (formerly NPS Research Office) located within the parks. They are documented in the parks' Natural Resources Management Plan and updated annually. Such research may include in- house studies, interagency or cooperative agreements, contracts, or independent investigations. All fire related research is closely coordinated with the fire operations and fire monitoring efforts in order to assure maximum application of findings to both the management and interpretation programs. A Fire Research Coordinator within the Science and Natural Resources Management Division assists in coordinating these efforts. A report is produced annually documenting all fire- related research, monitoring, and inventory projects undertaken within a given year.

Most fire research is carried out in close conjunction with the prescribed burning program, utilizing planned burns to the extent possible. On occasion, burns will be carried out specifically to support approved research projects. These might include efforts to study the effects of variable intensity burns, reburns, or burns carried out under specific climatic or prescription variables (e.g. severe drought).

FIRE RESEARCH NEEDS

Fire research is directed at answering questions related to short- term, specific operational or resource issues or at big picture ecosystem wide problems that may have long- term or far-reaching implications for park management. Specific research questions may be addressed by park staff, staff from other agencies (e.g. USGS), or by outside researchers. Current research needs focus on obtaining a better understanding of spatial and temporal patterns of past fire regimes, the effects of fire intensity and frequency on fuel accumulation and on forest structure and dynamics, and the many effects of variable fire intensities and return intervals, as well as fire suppression, on vegetation, fauna, pathogens and other ecosystem properties. The question of the extent to which contemporary vegetation and fuels vary from their natural range has been difficult to determine yet remains a key factor for guiding fire management decisions. The following specific fire- related research needs have been identified:

Fire and Global Change: Understanding Forest Dynamics, Succession Modeling, Climate and Vegetation History, and Ecology of Sequoia - Mixed Conifer Forests

Aspects of this comprehensive need are currently being addressed by ongoing studies by and through the USGS Research Office. These are addressing vegetation and fire history over millennial time scales, forest structure, fuel accumulation and modeling, effects of variable fire intensity on pathogens and cambium and soil temperatures and various aspects of nutrient cycling. Beyond the continuation and expansion of the above projects, additional research is needed relating to mixed conifer forest fire ecology including expanded studies of fire and vegetation history (in conjunction with larger proposed studies of global change), plant succession and forest dynamic models (to permit testing of predictive outcomes of different climate and management scenarios), and fire spread modeling.

Role of Fire in Sierran Ecosystems

- **Improve the Reliability of Information Used to Derive Desired Structural/Process Goals**
  These conditions were established by the November 1998 Sacramento workshop "Setting Resource Objectives for Fire Management Plans". Defining the desired goals used in this ecosystem management process requires an understanding of basic reference conditions at various landscape levels. Currently our knowledge of these reference conditions is poor, of low resolution, and only provides a broad target window for fire management planning. At this time, of the two goals, past process conditions can probably be more easily and reliably reconstructed.

  - **Structural Goals**
    These goals include landscape pattern, physical and biological attributes of stand structure, and their drivers. This information need encompasses pre- Euro- American settlement tree ages and age distributions, species diversity, size structure by vegetation type, gap and patch size, shape and arrangement on the landscape, species composition, and burn severity by topographic position. A variety of sources may potentially provide this information including historic photography, TM images, and field investigations. Changes in attributes such as species diversity could be obtained

by investigating changes pre- /post- fire, after multiple burns in an area, and by following burns with differences in seasonal timing and burn intervals (also see cross-scale burn severity below).

  - **Process Goals**
    These goals include an understanding of the attributes of pre- Euro- American settlement fire regimes, drivers of these regimes, and the relationship between these and other agents of change. While considerable fire history sampling has been carried out within the parks (Kilgore and Taylor 1979; Pitcher 1987; Swetnam and others 1992; Swetnam and Caprio 1995; Swetnam and others 1998; Caprio 1999) many significant gaps still exist in our knowledge (Caprio and Lineback 1997). Information needs include obtaining an improved understanding of the historic size, frequency, type, and intensity of fire, and a comparison of the extent of historic fire patterns across the landscape and for the various vegetation types within the parks. Additionally, an evaluation of the constraints imposed by the presence of modern park developments and park neighbors is needed. This information will help define areas where the restoration of the historic fire regime and patterns may be constrained.

- **Cross- Scale Burn Severity Through Several Burns**
  Patterns and changes in patterns of burn severity would be examined over time as repeated burns occur on the landscape. This would provide information on spatial and temporal patterns of burn severity and how they change as multiple burns occur. For example, does fire size change between the first and second burns. Specific projects might include looking at fire records and burn maps from the Sugarloaf (SEKI) and/or Illilouette (YOSE) Valleys.

- **Fire Ecology of Low Elevation Mixed Conifer and Hardwood Forests**
  Research is needed to better understand the role of fire in the transition zone between the foothill chaparral and the mixed conifer forests. This should include studies of fire history, fuel loading, and vegetation structure and succession, as well as modeling of fuels, fire behavior and fire spread. This key zone between the highly flammable foothill and sensitive sequoia forests is extremely important to the overall fire management strategy of the parks.

- **Subalpine Forest Fire Ecology**
  Despite an active program of allowing natural fires to burn in the higher elevations of the Parks little is known about fire history and effects in most of these ecosystems. Such data is needed for lodgepole pine, red fir and other subalpine forest types as well as for subalpine meadows, which comprise a significant portion of the parks' vegetation. Our current knowledge of fire effects in these types is largely confined to studies of limited extent carried out by Kilgore (1972), Pitcher (1980, 1987) or presently underway by Battles and Newburn (2000) and Caprio (2000).

Fire Modeling and Data Needs

- **Fire Behavior Modeling**
  Modeling for the prediction of fire behavior, such as the BEHAVE/FARSITE systems, and the development of Geographic Information Surveys for the storage of fuels data

- **Historic Fire Spread Patterns**
  Model fire spread patterns of fires originating from ignition starts that have occurred over last X number of years to see whether burn patterns/frequency fir with past patterns or does data suggest Native American burning was important.

Air Quality

Research is needed to determine the number of acres that can be burned without violating air quality regulations. Monitoring equipment is needed to establish baseline particulate loading in park airsheds and what is the contribution of the parks burn program. By knowing how many pounds of particulates or CO are produced per ton of any given fuel, and by studying the indicators of good and bad smoke dispersion days, improved prescriptions may be written for smoke management, as is done for fire behavior and effects.

Watershed Impacts

A better understanding of both transitory and long- term effects on watershed features related to the presence or absence of fire. Included would be hydrologic and sedimentation impacts, stream chemistry, and changes in soils. Studies are needed that provide results from replicated watersheds in a variety of setting such as differing vegetation and parent material.

Wildlife

Several potential research/resource study projects for examining the relationship between fire and wildlife. These include:

- Fire or absence of fire and its effects on particular wildlife species. Particular taxa would include terrestrial amphibians, bats, spotted owls, and fishers.
- Historic role of fire in maintaining winter range of bighorn sheep in the Kern and Big Arroyo drainages. For example, did fire historically keep areas open that are now very brushy? This could be addressed by either looking at historic photos or by reconstructing the fire history of the area.
- What are the effects of tussock moth on forest structure, composition, and fuels relative to prescribed burns? Do these effects differ between areas burned prior to the moth outbreak?

Fire Effects on Sensitive or Endangered Species

Fire effects or the effect of the lack of fire on sensitive or endangered plants and animals within the parks. Wildlife species might include fishers, spotted owls, or Sierra bighorn sheep. For example, recent interest has been expressed on the relationship between fire and bighorn sheep habitat. Potential investigation might include looking at change in habitat and foraging behavior that might occur with future fires and understanding the relationship between fire and sheep habitat in the past (prior to Euroamerican settlement).

Exotic Plants and Animals and Fire

While dramatic changes in most low elevation grasslands occurred over a century ago new invasions or potential invasions of exotic species are still occurring or threaten. For example, in

the last three years the widespread occurrence and dominance of cheatgrass has become apparent. While multiple factors are usually important in the spread, establishment, and dominance of these invasive species fire can sometimes have a significant role. Studies are needed to investigate the role of fire in association with other factors in the spread of established or threatening exotics. In general, studies are needed to determine:

- strategies to detect the presence and changes in exotics over time
- what are the interactions between fire and other management practices (roads/stock etc.) on establishment and spread of exotic species
- can methods be developed to eliminate particular exotic species or at least retard their spread

Fire Restoration Needs

A long- term examination of fire restoration potential is needed. For example, at what interval can fires occur in various vegetation types and still maintain the character and integrity of the ecosystem. Can we maintain systems that burned at 5- year intervals historically with a 10- year fire return interval? Additionally, how important is the fire return interval distribution of fire (Bond and Wilgen 1996) or the variation in intervals from fire- to- fire? Again can we use patterns that are different from pre- settlement patterns and still maintain ecosystem integrity. These extend the JFS Fire and Fire Surrogates work currently underway within the parks.

Conversion of Sequoia Tree Inventory into Digital Format

An exhaustive inventory of all giant sequoia trees in the parks was carried out under contract in the 1960's and 70's. This data has great potential value to both management and science programs. However, it currently exists only in hard copy form and is of limited utility. Converting the paper database into a digital georeferenced format and georeferencing tree locations would greatly increase the utility of this dataset.

SENSITIVE RESEARCH AREAS

Specific "*Sensitive Research Areas*" may be designated to support particular research projects or objectives. The purpose of these areas is to provide a mechanism for identifying and highlighting areas in the fire planning process where special considerations are required during implementation of burns. These areas would include fire research plots where the effects of variable fire intensities, intervals or fuel conditions might be under study. Plots would be variable sized areas established by the park's fire monitoring and USGS research programs, university scientists and other federal agencies. One special type of *sensitive research area* would be sites where fire exclusion is called for. These areas will be individually justified and managed according to objectives stated in approved research project plans and be subject to annual or periodic review. These areas would fall into two categories:

Temporary Areas

Sites that may be used for a limited amount of time or set aside to be excluded from one

particular burn (these would be most applicable to prescribed fire situations). They might be designated in either unburned areas or in areas that have burned at some point in the recent past. The number of sites would be dynamic on a year- by- year basis. An example would be the Giant Forest Joint Fire Science (JFS) "fire and fire surrogates" study area where several control treatments will be paired with burn treatments. Control areas will be maintained for the life of the study (~5 yr.) but will revert back and be included in any additional fire operations planning with the completion of the study. Examples include:

- Giant Forest Joint Fire Science program plots
- Cheatgrass plots in Cedar Grove
- Pitcher Plot #3 - Desired plan: to miss the next prescribed fire in the area. Reason: to act as control for Plots 1 and 2 that were burned during 1999. This will permit effects of the burns in plots 1 and 2 to be more accurately compared to a similar unburned area in which similar long- term data has been collected.

Long- term or Semi- Permanent Areas

Areas where fire is being actively excluded in an effort to evaluate the effects of long- term fire exclusion on ecosystem properties. These would be sites without a definite life span or annual evaluation. Location and designation of these areas will be based on specific criteria such as feasibility of fire control or exclusion and the value of long- term maintenance to the parks research program. An example of such a site would be the 49.8 ha Log watershed in Giant Forest that has been paired with the burned Tharps watershed in several long term studies of acid deposition and fire on ecosystem properties.

E - Fuels Management Prescriptions

MECHANICAL HAZARD FUELS ABATEMENT STANDARDS

Hazard Abatement Adjacent to Structures, Around Developments, and Along Park Boundary Areas

The following standards will be used for hazard fuels abatement projects conducted by park crews on NPS lands.

The removal of exotics should be favored over the removal of native species. Where feasible, exotics should be eliminated while native plants should be pruned or isolated from the ladder effect in order so that they may remain while providing a reasonable level of protection for structures.

There may be sensitive native plants in certain areas and the removal of nesting trees should be done after birds have vacated the nests. Coordinators of abatement projects will need to consult with the park biologist before cutting questionable plant species or nesting trees.

Foothill Areas

In foothill areas where annual grass and shrub species comprise the main hazardous fuels, most mechanical reduction work is done immediately adjacent to structures. The following standards are based on PRC 4290.

- Mow or cut dried grass from the sides of structures out to a minimum 30 foot width from the structures in all directions. On steep hillsides mow or cut dried grass out to a distance of up to 100 feet on the downhill portion. Individual live shrubs or trees can remain as long as they are isolated from the ladder effect—the path that fires can travel in order to reach the structure's sides or roof area.
- Along the sides of flammable foundations, scrape away fuels down to bare mineral soil. A 2 to 3 foot wide scrape is recommended.
- Remove all leaf litter from roofs.
- Remove all dead branches within a reasonable distance above roofs (some conifer trees could have dead branches high up in the tree that are not reachable).
- Remove all branches or vegetation within 10 feet of chimney outlets.
- All fireplace or wood stove chimney outlets must be covered with an ember- arresting screen that has openings no larger than ½ inch in size.
- Limb- up all trees 6 to 8 feet above the ground and that are within a minimum area 30 feet out from structures in all directions.
  - When removing a lateral branch at its point of origin on the trunk or parent limb, the final cut shall be made in branch tissue close to the trunk or parent limb, without cutting into the branch bark ridge or collar, or leaving a stub.

  - When removing a dead branch, the final cut shall be made just outside the collar of live tissue. If the collar has grown out along the branch stub, only the dead stub shall be removed. The live collar shall remain intact and uninjured.
  - To prevent damage to the parent limb when removing a branch with a narrow branch attachment, the final cut shall be made from the bottom of the branch up.
  - Tree branches shall be removed in such manner so as not to cause damage to other parts of the tree. Branches too large to support with one hand shall be pre- cut to avoid splitting or tearing of the bark.
- Piles shall be appropriately sized and located in openings far enough away from residual vegetation in order to prevent or minimize scorch.
  - Piles shall have a minimum height of 3 feet and a maximum height of 6 feet.
  - Piles shall be located at least 15 feet from any residual green tree in the downhill or side-slope direction from the pile, and at least 20 feet from any residual green tree upslope of the pile.
  - Piles shall be constructed reasonably compact and free of soil to facilitate burning.
  - Piles shall also be constructed with enough fine material (less than ¼ inch diameter), such as twigs and needles, to easily ignite and burn the pile.
  - All piles should have a good base to prevent the pile from toppling.
  - Piles shall be covered with durable paper prior to precipitation. Water- resistant "Kraft" paper (Clean Burn Kraft Paper – available from http://www.baileys-online.com/store.html) or approved substitute may be used. No plastic material will be used to cover piles. The covering shall be placed over the center of the pile. The paper shall cover a minimum of 75% of the surface of each pile.
  - Pieces of branch wood shall be placed on the top to secure the paper against reasonable wind events.

Mid- elevation Areas

In mid- elevation areas where timber species comprise the main hazardous fuels, mechanical reduction work is done immediately adjacent to structures and out to about a 200- foot width on average in all directions. On steep slopes the areas down hill or below structures may need mechanical reduction work wider than 200 feet. In timber fuels shaded fuel break techniques are used. The following standards are based on PRC 4290.

- Remove flammable vegetation or leaf litter from the sides of structures to 30 feet out from the structures in all directions. Individual live shrubs or trees can remain as long as they are isolated from the ladder effect—the path that fires can travel in order to reach the structure's sides or roof area.
- Along the sides of flammable foundations, scrape away fuels down to bare mineral soil. A 2 to 3 foot wide scrape is recommended.
- Remove all leaf litter from roofs.
- Remove all dead branches within a reasonable distance above roofs (large conifer trees could have dead branches high up in the tree that are not reachable).
- Remove all branches or vegetation within 10 feet of chimney outlets.
- All fireplace or wood stove chimney outlets must be covered with an ember- arresting screen that has openings no larger than ½ inch in size.

- There will be a maximum of 25 trees/acre less than 40 feet in height remaining after the thinning.
- All live trees over 40 feet tall will remain uncut. All larger trees remaining will be limbed up to at least 6 to 8 feet above the ground.
  - When removing a lateral branch at its point of origin on the trunk or parent limb, the final cut shall be made in branch tissue close to the trunk or parent limb, without cutting into the branch bark ridge or collar, or leaving a stub.
  - When removing a dead branch, the final cut shall be made just outside the collar of live tissue. If the collar has grown out along the branch stub, only the dead stub shall be removed. The live collar shall remain intact and uninjured.
  - To prevent damage to the parent limb when removing a branch with a narrow branch attachment, the final cut shall be made from the bottom of the branch up.
  - Tree branches shall be removed in such manner so as not to cause damage to other parts of the tree. Branches too large to support with one hand shall be pre- cut to avoid splitting or tearing of the bark
- Felled trees will be limbed and bucked down to an 8- inch top and piled for later burning. Tree boles larger than 8 inches in diameter will be left un- bucked. All tree boles left will remain in contact with the ground. All stumps will be flush cut and added to the burn piles.
- Dead & down woody material (1- 8 inches in diameter) will be gathered and piled with larger logs limbed and bucked to an 8- inch top and piled for later burning. Tree boles larger than 8 inches in diameter will be left un- bucked.
- Piles shall be appropriately sized and located in openings far enough away from residual vegetation in order to prevent or minimize scorch.
  - Piles shall have a minimum height of 3 feet and a maximum height of 6 feet.
  - Piles shall be located at least 15 feet from any residual green tree in the downhill or side-slope direction from the pile, and at least 20 feet from any residual green tree upslope of the pile.
  - Piles shall be constructed reasonably compact and free of soil to facilitate burning.
  - Piles shall also be constructed with enough fine material (less than ¼ inch diameter), such as twigs and needles, to easily ignite and burn the pile.
  - All piles should have a good base to prevent the pile from toppling.
  - Piles shall be covered with durable paper prior to precipitation. Water- resistant "Kraft" paper (Clean Burn Kraft Paper – available from http://www.baileys-online.com/store.html) or approved substitute may be used. No plastic material will be used to cover piles. The covering shall be placed over the center of the pile. The paper shall cover a minimum of 75% of the surface of each pile.
  - Pieces of branch wood shall be placed on the top to secure the paper against reasonable wind events.
- Larger brush patches will have a minimum 20- foot wide path cleared, and the cut material piled for later burning to facilitate future fire line construction located in a defensible area within the treatment area.
- Any stumps larger than 8 inches in diameter will be treated with borax to prevent root rot.

The treatment zone will be maintained on a regular and recurring basis.

- Established seedlings and saplings will be thinned every 10- 15 years to maintain stocking densities at prescribed levels favoring shade intolerant species. The slash generated will be piled and burned.
- The 20- foot wide cleared brush zone will be maintained by cutting sprouting brush on a 3- 5 year cycle. The cut material will be piled and burned.
- Re- accumulations of dead & down woody material will be gathered and piled with larger logs limbed and bucked to an 8- inch top and piled for later burning on a 1- 2 year cycle.

Hazard Abatement Along Boundary Areas

Where hazard abatement along park boundary areas needs to be implemented, the treatments will follow the shaded fuel break methodology described above. For brevity reasons those standards are not duplicated here.

PRESCRIBED FIRE BURNING PRESCRIPTIONS

Table E-1 – Prescriptions for Fuel Models 1-5

	Fuel Model 1 Annual Grass Head Fire Wind Upslope	Fuel Model 1 Annual Grass Backing Fire Wind Upslope	Fuel Model 2 Annual Grass with Overstory Head Fire Wind Upslope	Fuel Model 2 Annual Grass with Overstory Backing Fire Wind Upslope	Fuel Model 4 Tall Brush Head Fire Wind Upslope	Fuel Model 5 Low Brush Head Fire Wind Upslope
Environmental Conditions						
Air Temperature	30–90 f	30-90 f	30-90 f	30-90 f	30-85 f	30-80 f
Relative Humidity	20–60%	20-60%	20-60%	20-60%	20-60%	20-60%
Wind Speed	See Below	See Below	See Below	See Below	See Below	See Below
Slope	0–30%	0-100%	0-30%	0-100%	0-45%	0-35%
Fuel Moisture						
1 Hour Time Lag	5-10% mfws 0-2	3-4% mfws 0-4 5-10% mfws 0-2	6-11% mfws 0-2 12-13% mfws 0-6	4-9% mfws 0-4 10-13% mfws 0-2	5-9% mfws 0-4 10-12% mfws 0-8	5-7% mfws 0-2 8-12% mfws 2-8 w/ live fuel moisture of 100-150%
10 Hour Time Lag	N/A	N/A	7-12% mfws 0-2 13-14% mfws 0-6 15-16% mfws 0-10	5-10% mfws 0-4 11-14% mfws 0-2	6-10% mfws 0-4 11-13% mfws 0-8	6-12% mfws 0-2 9-13% mfws 0-8 w/ live fuel moisture of 100-150%
100 Hour Time Lag	N/A	N/A	8-13% mfws 0-2 14-15% mfws 0-6 16-17% mfws 0-10	6-11% mfws 0-4 12-15% mfws 0-2	7-11% mfws 0-4 12-14% mfws 0-8	N/A
1,000 Hr Time Lag	N/A	N/A	N/A	N/A	N/A	N/A
Live	N/A	N/A	50-100%	50-100%	50-150%	70-150%
Fire Behavior Outputs						
Scorch Height	N/A	N/A	0-30 ft.	0-30 ft.	N/A	N/A
Rate of Spread	2-35 chains/hour	2-8 chains/hour	1-16 chains/hour	1-3 chains/hour	2-120 chains/hour	2-17 chains/hour
Flame Length	0-4 ft.	.5-2 ft.	.5-4 ft.	.5-2.5 ft.	3-25 ft.	1-5 ft.
Heat per Unit Area	55-95 BTU/sq. ft.	100-110 BTU/sq. ft.	255-495 BTU/sq. ft.	255-525 BTU/sq. ft.	1570-2910 BTU/sq. ft.	215-715 BTU/sq. ft.
Fireline Intensity	3-60 BTU/sq. ft./second	4-15 BTU/sq. ft./second	4-145 BTU/sq. ft./second	4-30 BTU/sq. ft./second	50-6330 BTU/sq. ft./second	7-221 BTU/sq. ft./ second

NOTE: These are generalized burning prescription parameters. Fire management staff are responsible for reviewing topography outside the range listed and adjusting ignition pattern and rate of firing in order to meet burn plan objectives. Reduction of scorch can be accomplished as needed generally with nighttime ignition and with humidities higher than 30%.

Table E-2 – Prescriptions for Fuels Models 8-10

	Fuel Model 8 Closed Timber and Short Needle Conifer Head Fire Wind Upslope	Fuel Model 9 Broadleaf Deciduous Hardwoods and Long Needle Pine Head Fire Wind Upslope	Fuel Model 9 Broadleaf Deciduous Hardwoods and Long Needle Pine Backing Fire Wind Upslope	Fuel Model 10 Timber Litter Head Fire Wind Upslope	Fuel Model 10 Timber Litter Backing Fire Wind Upslope
Environmental Conditions					
Air Temperature	40-85 f	40-85 f	40-85 f	40-75 f	40-85 f
Relative Humidity	20-60%	20-60%	20-60%	20-60%	20-60%
Wind Speed	See Below	See Below	See Below	See Below	See Below
Slope	0-60%	0-45%	0-100%	0-45%	0-100%
Fuel Moisture					
1 Hour Time Lag	3-10% mfws 0-10	5-7% mfws 0-6 8-12% mfws 0-8	3-10% mfws 0-4	5-7% mfws 0-6 8-12% mfws 0-8	3-10% mfws 0-4
10 Hour Time Lag	4-11% mfws 0-10	6-8% mfws 0-6 9-13% mfws 0-8	4-11% mfws 0-4	6-8% mfws 0-6 9-13% mfws 0-8	4-11% mfws 0-4
100 Hour Time Lag	5-12% mfws 0-10	7-9% mfws 0-6 10-14% mfws 0-8	5-12% mfws 0-4	7-9% mfws 0-6 10-14% mfws 0-8	5-12% mfws 0-4
1,000 Hr Time Lag	10-20%	10-20%	10-20%	10-20%	10-20%
Live	N/A	N/A	N/A	N/A	N/A
Fire Behavior Outputs					
Scorch Height	0-30 ft.	0-30 ft.	0-30 ft.	0-30 ft.	0-30 ft.
Rate of Spread	0-8 chains/hour	1-18 chains/hour	0-1 chains/hour	1-18 chains/hour	0-1 chains/hour
Flame Length	0-2.5 ft.	1-4 ft.	.5-3 ft.	1-4 ft.	.5-3 ft.
Heat per Unit Area	165-225 BTU/sq. ft.	320-390 BTU/sq. ft.	350-450 BTU/sq. ft.	320-390 BTU/sq. ft.	350-450 BTU/sq. ft.
Fireline Intensity	1-35 BTU/sq. ft. /second	4-120 BTU/sq. ft. /second	4-60 BTU/sq. ft. /second	4-120 BTU/sq. ft. /second	4-60 BTU/sq. ft. /second

NOTE: These are generalized burning prescription parameters. Fire management staff are responsible for reviewing topopgraphy outside the range listed and adjusting ignition pattern and rate of firing in order to meet burn plan objectives. Reduction of scorch can be accomplished as needed generally with nighttime ignition and with humidities higher than 30%.

F - GIS Data Management Plan

Geographic Information Systems (GIS) are an essential tool for a successful fire and fuels management program. The technologies used and capabilities of GIS are evolving rapidly. This section of the Fire and Fuels Management Plan describes GIS data management objectives, roles and responsibilities, hardware and software, existing data, data collection and analysis, and interagency collaboration.

It is very important that information be collected according to well- defined standards, managed to protect long- term data integrity, and be made accessible to the staff and public. It should be kept in mind that data management is a dynamic process and this document is subject to an annual review process where changes may be integrated.

This document does not address all fire data management activities at Sequoia and Kings Canyon National Parks, as many of these activities integrate with local parkwide and service-wide protocols, applications, and standards. This appendix addresses only those GIS data activities specific to these parks.

GIS DATA MANAGEMENT OBJECTIVES

1) Sufficient data is available to support park fire planning and operations.

2) All significant spatial data within the parks is adequately documented, archived, and secured using appropriate methodologies, tools and technologies.

3) Staff is adequately trained in the use of technologies, standards, and procedures.

4) Access to data and supporting documentation is easy to use, readily retrievable, and well documented through use of available NPS and NIFC software systems and Internet technologies.

5) Data collection and data handling protocols follow approved standard operating procedures, incorporate appropriate standards, and meet best science standards.

6) The parks' participate in interagency cross- boundary data development initiatives such as the Southern Sierra Geographic Information Cooperative (SSGIC).

ROLES AND RESPONSIBILITIES

Fire GIS Specialist

A permanent GS- 9/11 Fire GIS Specialist is duty stationed at SEKI and supervised by the GIS Coordinator under the Division of Natural Resources. This position is FIREPRO funded and a minimum of 80% of the position supports GIS and fire and fuels management information activities. The GIS Specialist is responsible for providing data, analysis, and services for fire planning and operations and works closely with the fire management staff and the GIS Coordinator. Support is provided to interagency GIS initiatives as needed to support landscape level GIS data management and analyses. This position also assists with providing GIS and GPS training to park staff, ensures data backups and documentation of data and processes including metadata, resolves technical support questions from staff, and handles basic system administration functions for computer servers and workstations.

GIS Coordinator

The GIS Coordinator manages the GIS fire budget, manages the overall direction for the GIS fire program, coordinates interagency GIS fire initiatives, and provides backup support to the Fire GIS Specialist.

HARDWARE AND SOFTWARE

Computer systems

At SEKI, data management is based on a Windows NT client- server model for distributing data and information. The parks' IT staff handle the overall administration of this network. The fire management staff has access to this internal network. All park GIS data now resides on one of two NT servers within this network. One server resides in the IT office and the other resides in the GIS office. It is expected that these two NT servers will be replaced by one new upgraded server in FY 2002 to be housed and maintained in the GIS office. All of the existing fire GIS data processing has been migrated from a Unix workstation to an NT workstation with significant savings in processing time and systems management overhead.

Archiving and Security

All digital data is backed up to one of two park NT data servers. These data servers are backed up to tape nightly. Rotating copies of the tapes are stored in a fire safe vault in the administrative offices at Ash Mountain headquarters. In conjunction with the IT staff, the GIS staff is creating standards and procedures for ensuring best data management practices relating to archiving and accessing data. Hardcopy log files are kept in the IT office and the GIS office for the server backups. Additional copies of the parks' GIS data tapes have been sent to the Seattle Support office for offsite storage and will be updated periodically.

Physical security is provided in the GIS lab for hardware systems. This room is accessible only by special key authority. Software system security is largely handled by the parks' IT staff through Windows NT. The Fire GIS Specialist and the GIS Coordinator both have system administrator access to the park servers for manipulating and creating datasets, and for granting users access to files.

Software and Data Accessibility

GIS Software
The parks use Arc/Info and Arcview for GIS processing and mapping. Several extensions to Arc/Info and Arcview are utilized, such as GRID, Spatial Analyst, and 3D Analyst. Arcexplorer is also available free for users to view data who do not have access to Arcview.

Arcview Theme Manager
This tool was initially developed by the Alaska region and has been used there for 5 years. In FY 1999 the Inventory and Monitoring program began looking at the GIS Theme Manager as a tool for packaging parks base cartography, vegetation, geology, and soils data. The GIS Theme Manager is an ArcView extension that facilitates the organization and use of data themes. This tool allows users to create lists of themes that are relevant to particular projects, areas or management issues. It catalogs these themes, so that a user simply selects a theme from a popup list and the Theme Manager adds it to a view along with a descriptive title, displays it with a legend, perhaps adds hotlinks or help files, and links it to metadata. Theme Lists may be maintained on a network location for all park users, created by Service- wide programs, like the Inventory and Monitoring Program and sent out to parks, or individuals may create their own personal lists for their data or specific projects. The GIS Theme Manager wizard steps users through the process, allowing users to easily: create, edit, copy, and delete theme lists. They can also create a set of environment variables for theme source paths, so that theme lists can be shared with other users who may have data stored on different drives or with somewhat different directory structures. The GIS staff maintains a set of theme lists on the parks' internal network for all users to access the major datasets. The GIS Theme Manager also provides some extra coordinate handling capabilities. By specifying the data and view projections, the user can click on the view and return the location in lat- long coordinates and UTM. One can also zoom to a lat- long coordinate and display the point on the view.

Metadata
Digital geo- spatial data will be documented using the FGDC Content Standards for Digital Geo- spatial Metadata, version 2. Currently the GIS staff is using the Arc/Info 8 Metadata tool for creation and maintenance of metadata.

Synthesis
Synthesis provides a means for linking and sharing data, information, and applications. It does not replace other databases and does not dictate the structure or function of other databases. Rather, it provides a set of pathways that link various sources of information. Installing Synthesis puts a large amount of information in the hands of park personnel. In addition to providing information from a standard interface, Synthesis includes a software toolbox that allows the user to create a custom interface and then link information to that custom interface. An interface/database created in this manner can be designed to serve park- specific information needs, with no programming expertise needed. SEKI has created a fire information section residing within Synthesis. This will include planning documents such as burn plans, photos, maps, and web links.

Internet
Public access to key fire information and data through the Internet is crucial to educating the public about the fire and fuels management process. In 2002, all fire web pages will be integrated

to provide better access to fire information in the parks. The parks also publish several geo-spatial databases, including fire data, to the NPS GIS Clearinghouse.

Training

GIS Staff
GIS data management staff needs to keep abreast of the latest technologies in computer software and interagency standards that apply to fire mapping in support of operations and planning. While no formal GIS training requirements currently exist at the national level, the California Firescope group has developed a training program specific to wildland operations fire GIS mapping. The fire GIS Specialist participated in this training in FY 2000.

Other Park Staff
At least one training class in Arcview is provided every other year to park staff by the GIS data management staff. GPS training has also been provided on an as- needed basis. Additionally, the GIS staff has provided updates to park staff on various Arcview tools, such as the Theme Manager, that improve the efficiency of data access.

EXISTING DATA

Fire data is integrated into parkwide strategies for managing data. A file directory structure standard was completed in 2000 with the purpose of standardizing the organization of documents, databases, imagery, and geospatial data in a distributed client- server environment. This process involved creating a complex empty file structure and then moving existing data, documents, imagery, and metadata into the appropriate directory structure. This file structure hierarchy was implemented at SEKI in 2000. This structure has simplified data access by providing standardized data locations so that tools such as Theme Manager and Synthesis can find these datasets.

GIS Data

Format
All geo- spatial data is currently in UTM, NAD27 coordinate system. Data are available in shapefile, Arc/Info, and Grid formats.

Existing park data
The Fire GIS Specialist maintains a list of geo- spatial data available on the parks' servers. Some data is also available on the internet.

Fire GIS
As per Chapter 8 of RM- 18, GIS has been used to look at Hazard, Risk, and Values, along with other analyses deemed pertinent to the fire management staff. These layers are derived annually from existing park data such as vegetation and fire history. The types of data and general processes are described in the "Data Collection and Analysis" section below under "Fire Analysis."

Vegetation mapping
The vegetation map is used as a basis to derive many fire analyses. The parks have undertaken a multi- year project to update the current vegetation map. Aerial photography from summer 2001 will be the basis for an improved vegetation layer.

Farsite

Park geo- spatial data has been processed into farsite landscape files. These data are updated on an annual or as- needed basis and made available on the park network data server. CD- ROMs will be available for Farsite data.

SACS Data

DI- 1202 forms are entered into the Boise SACS system for all wildland fires. This data is retrieved after the end of the year, from CD- ROMs or ftp from the NIFC IT office, and used to populate GIS tables for fire history. Currently two separate sets of tables are maintained for fire history, one for GIS and one from the 1202 system. A project has been undertaken by the fire GIS Specialist to validate the existing GIS database with the SACS 1202 database. This validation includes updating the SACS system with missing or incorrect information which will then be linked to the GIS. Since the fire numbering scheme is different in the two systems, a linkage table will need to be maintained. It is expected that this process will be completed in early spring 2002.

Plot Data

Plots come from a variety of sources and have multiple purposes including fire effects monitoring, fuels monitoring, and fire research. Plot locations are geo- referenced. Associated tabular data is stored on the park network server in the appropriate format and can be cross-linked to the geo- spatial plot locations. Data management of these tables is handled at the park level or at the program level.

DATA COLLECTION AND ANALYSIS

Fire Occurrence

Fire Locations and Verification
Fire locations are reported to fire dispatch in Latitude/Longitude format w/ decimal minutes (i.e., DD MM.99) or UTM. Point locations given on the Fire Report (1202) may not prove to be accurate when placed on a topographic map. GIS will be used to increase the accuracy of fire ignition locations by providing a map of the point location given. The burn boss will verify this location. GIS will maintain the point database on the central server.

Fire Size and Digitizing

a) **Fires < 10 acres** – Fires less than 10 acres will be captured as point locations and entered into the central GIS database. These points will be buffered with Arc/Info into polygons later in the fire history update process. An exception may be made to digitize the actual

area if it is determined that this area's location may play a significant role in monitoring (i.e., cheatgrass). All fires will originate as point locations.

b) **Fires > 10 acres** – Fires greater than/equal to 10 acres will be digitized from the 7.5' quad hand drawing, or from GPS points gathered at the fire site, either on the ground or from air reconnaissance. The perimeter will be shown on a map for the 1202 fire report. 7.5' topographic maps should NOT be shrunk or enlarged – when possible, submit the original topographic map to GIS for digitizing.
c) **GPS** – Where feasible, fire perimeters should be gathered via GPS. This reduces inaccuracies and saves time digitizing.
d) **Remote sensing** – A pilot project by the USGS's EROS data center using Thematic Mapper satellite imagery is being examined by the fire GIS Specialist and fire ecologists to determine if this will be a useful method for gathering fire perimeters and burn severity data. An initial assessment was completed by EROS for fires during 2001, but a determination of the usefulness of this data could take several summers of field verification. The data is fairly course (30 meters pixels) and seems to have difficulty picking up changes in heavy canopy. Also, the availability of scenes was very limited in 2001 with much shadowing obscuring some of the changes.

Fire History

Fire history in the parks was originally compiled through the process of researching and digitizing old maps. There are several types of these old maps. The GIS office produced a set of topographic maps that were used as the original base maps for digitizing into GIS. The Fire Management Office retained a set of maps collectively known as the fire atlas. Both of these sets of maps have been moved to the museum archives. The individual fire records are also located in the museum archives. Currently, fire history is updated digitally by following the processes listed in a) and b) in #2 above. The GIS processing protocols are documented on the internal server. The database information attached to the geo- spatial data is entered into an access table from the data received back from the SACS system, exported to a dbf and joined to the GIS. This process will be updated as described in Section D under "SACS Data" earlier in this Appendix (Appendix G).

Fire Analysis

Several types of fire analysis are processed in the early spring following the compilation of fire history from the previous calendar year. Stored with each of these datasets is a processing protocol document available for GIS technicians.

Fuels

A fuels layer is derived by reclassifying vegetation and applying a weighting factor for the Fire Return Interval Departure (FRID) to account for greater fuel buildup in some areas. The fuels specialist provides a table each year specifying the classification of fuel models.

Hazard

A hazards layer was derived from a combination of slope, aspect, fuels, and elevation. A group of fire ecologists met with the GIS staff to determination a weighting scheme with the assumption that a factor such as a steep slope would pose a greater risk to control than a south- facing slope.

Risk
Risk data has been created from fire history by generating a point ignition file from either the reported fire start location, or a location derived by GIS from the center point of the GIS database location. The point ignition data can then be categorized into types of risk, such as lightning risk or human caused ignition risk.

Values

Ecological Need for Fire
This process, locally known as FRID (Fire Return Interval Departure) was also developed by fire ecologists and the GIS staff. It uses fire history and the estimated historic fire regime to reclassify vegetation. The known fire history year is subtracted from the current year giving the number of years since fire. This is then compared to the historic fire return interval to determine how much an area has deviated from the return interval. This is a significant planning tool for locating fuel buildup. GIS can identify locations of concern for field reconnaissance.

Knowledge of Historic Fire Regime
Knowledge of historic fire regimes in the parks is an ongoing research project. The fire history specialist has compiled a table from intensive research using tree- ring samples and historic documents. This table is the crux of the fire analysis process. It projects an estimate of the historic fire return interval for each vegetation type in the parks. The current focus of research is distinguishing between fire history on different slope aspects. The results of this research will allow the fire management program to refine its estimate of fire return interval departure.

Base Cartographic Data

The Fire GIS Specialist is involved with several projects to develop and maintain other supporting cartographic data, such as building locations, roads, air hazards, etc.

INTERAGENCY COLLABORATION

The 1995 Wildland Fire Policy, and now the 2001 National Fire Plan, both emphasize Interagency collaboration. Sequoia and Kings Canyon National Parks are currently participating in the Southern Sierra Geographic Information Cooperative (SSGIC). This project is focused on developing and testing an approach to incorporate wildland fuels information management into an interagency, landscape- scale planning framework. The project area includes six major watersheds (Kaweah, Kern, Kings, Caliente, Mojave, and Tule watersheds) covering an area of about 4.7 million acres. A spatial and attribute information system is being created for coordinated fuels management planning within an integrated Geographic Information System (GIS) framework.

The interagency group has been established with member representation at the County, State, and Federal level. The primary goals are to reduce fiscal costs to both government agencies and the public and to improve attainment of ecological and hazard reduction goals across jurisdictional boundaries. The project focuses on utilizing geographic information and related

technologies including the Internet to overcome institutional and organizational barriers to interagency fuels management within very large, diverse ecosystems.

The proposed framework will be both consistent and dynamic to meet the varied long- range ecological, fire hazard, and risk reduction goals of all impacted agencies. Common geographic data is being developed including comprehensive planning maps and analyses that prioritize areas for treatment based on value, hazard, and risk criteria. This framework will develop and test procedures to manage and update complex spatial information and to institutionalize the coordinated planning efforts.

G - Organization Charts

Since the fire and fuels management program is comprised of staff members in more than one division, six organization charts are necessary to understand organizational structure:

1. **Sequoia and Kings Canyon National Parks & Devils Postpile National Monument** – This chart displays the organization of divisions under the superintendent. The divisions with fire and fuels management positions are highlighted.

2. **Division of Fire and Visitor Management** – This chart displays the organization of the Fire and Aviation branch of the Fire and Visitor Management Division.

3. **Kings Canyon District** – This chart displays the organization of the Kings Canyon Fire District under the Division of Fire and Visitor Management.

4. **Sequoia District** – This chart displays the organization of the Sequoia Fire District under the Division of Fire and Visitor Management.

5. **Division of Interpretation and Cultural Resources** – This chart displays the partial organization of the Division of Interpretation and Cultural Resources as it pertains to fire and fuels management.

6. **Division of Natural Resources** – This chart displays the partial organization of the Division of Natural Resources as it pertains to fire and fuels management.

Figure G-1 – Organization Chart for Sequoia & Kings Canyon National Parks and Devils Postpile National Monument

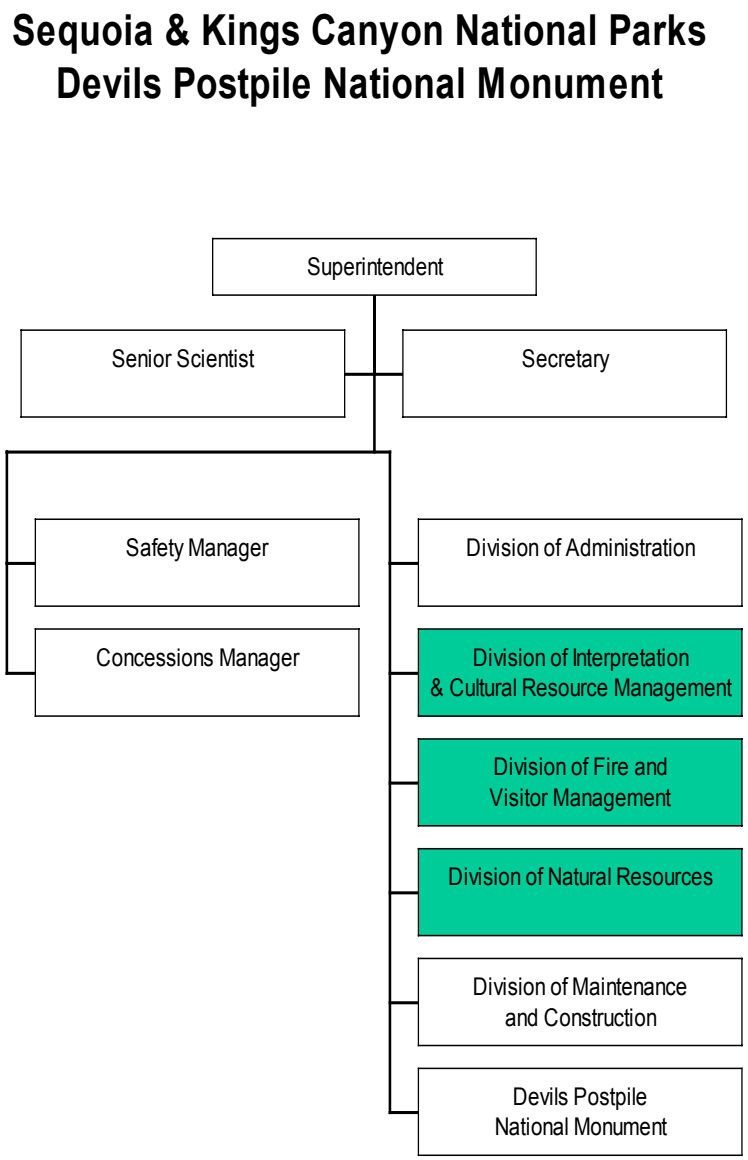


Figure G-2 – Organizational Chart for Division of Fire and Visitor Management

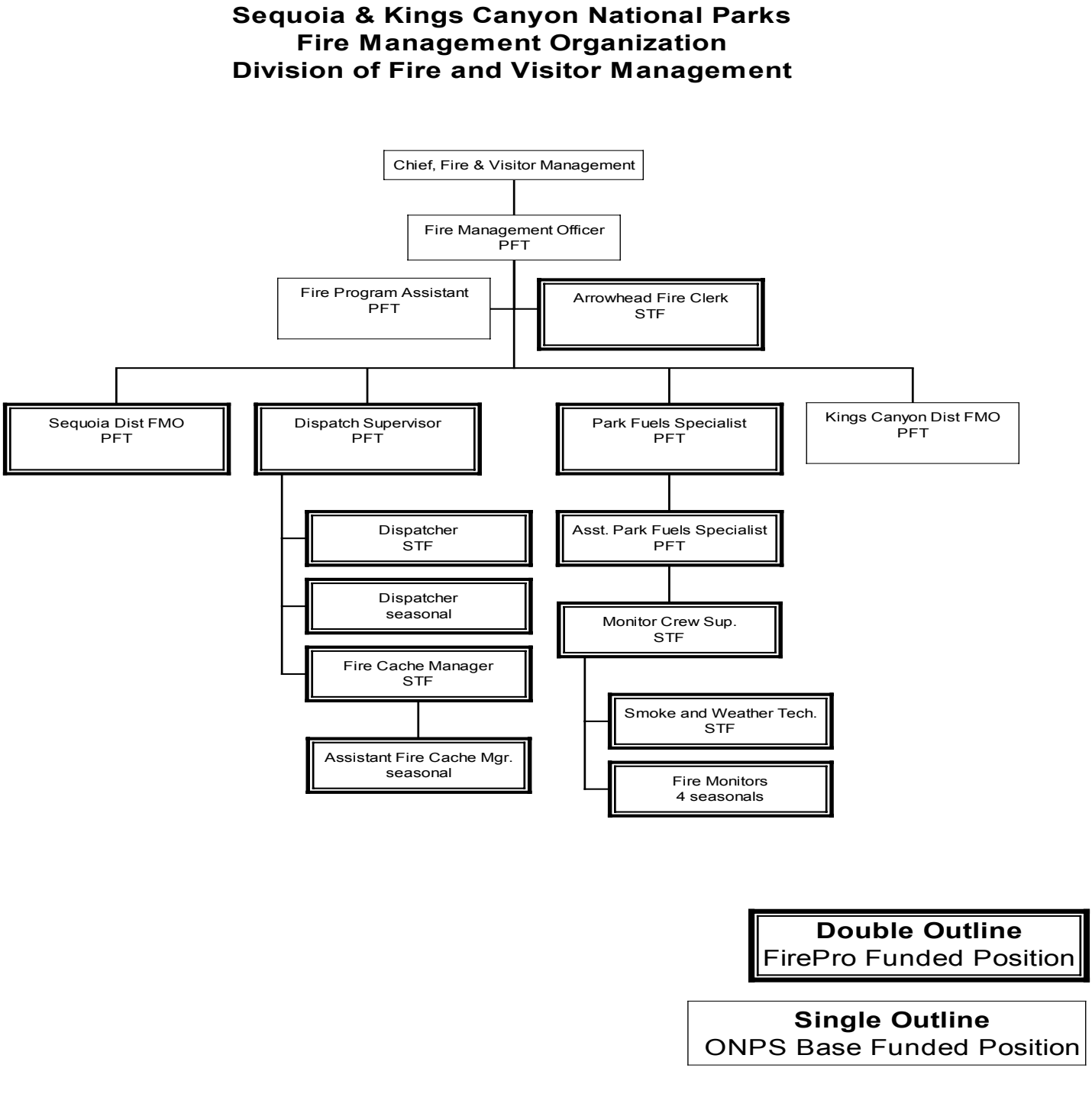


Figure G-3 – Organization Chart for Kings Canyon District

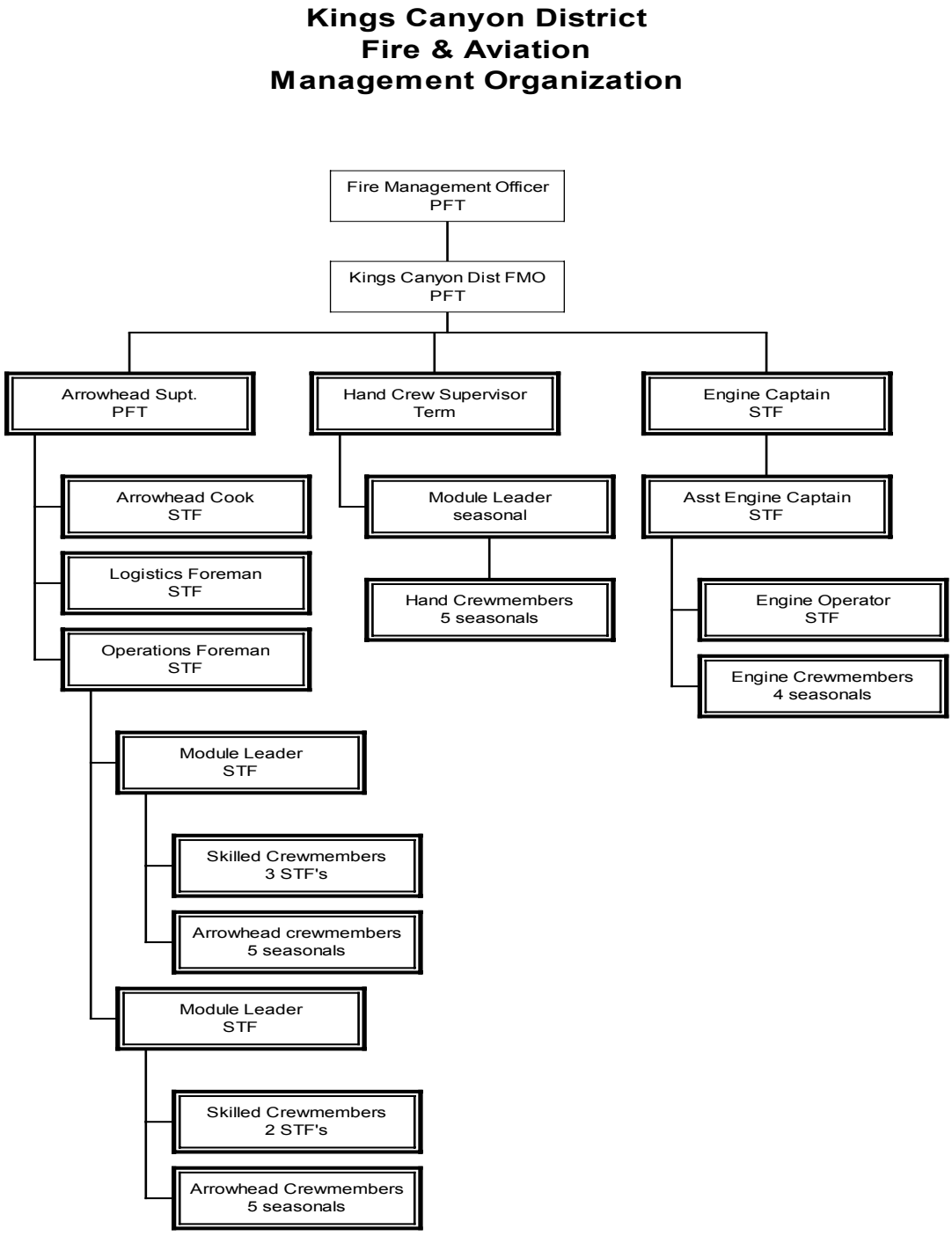


Figure G-4 – Organization Chart for Sequoia District

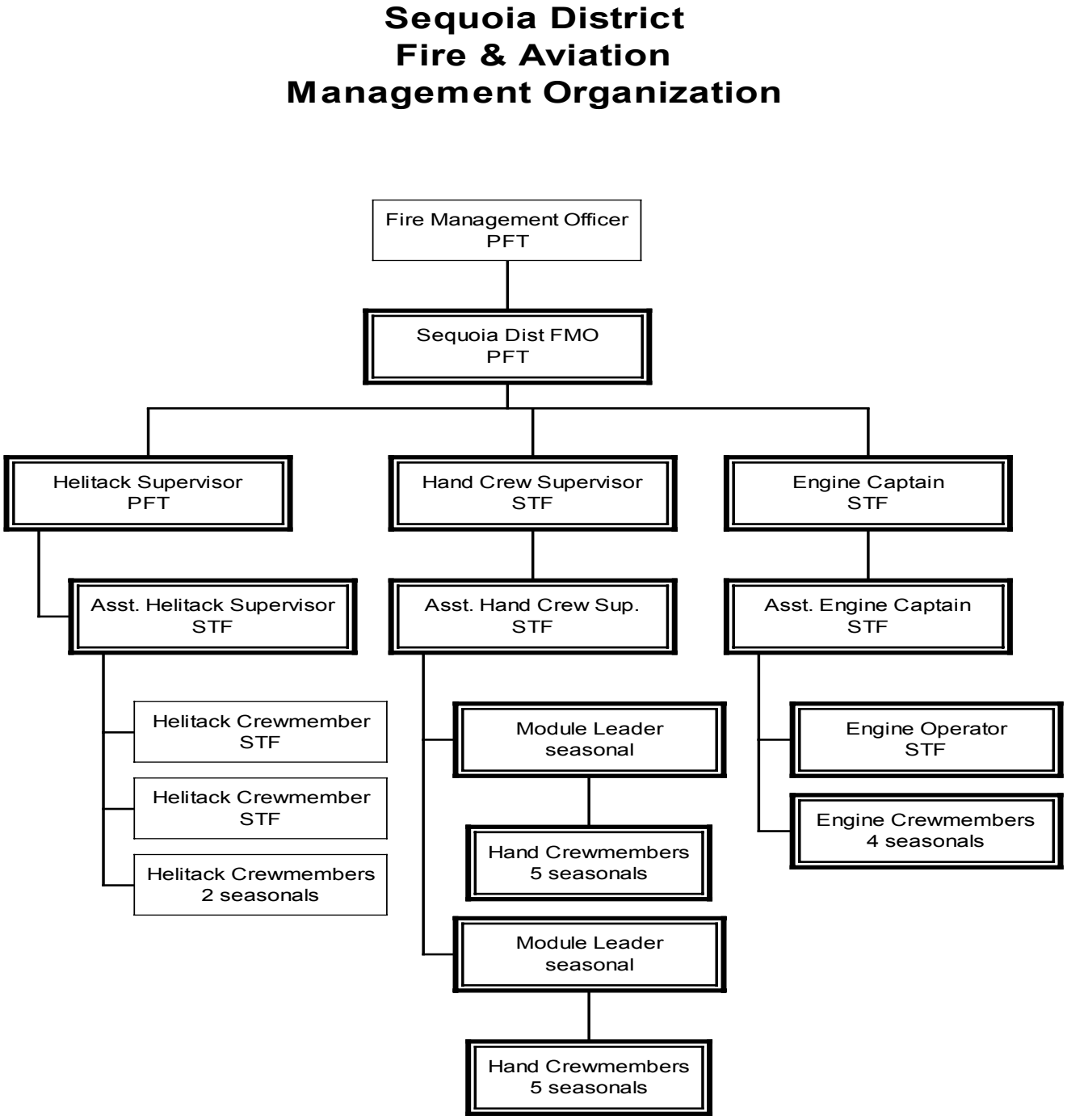


Figure G-5 – Organization Chart for Division of Interpretation and Cultural Resources

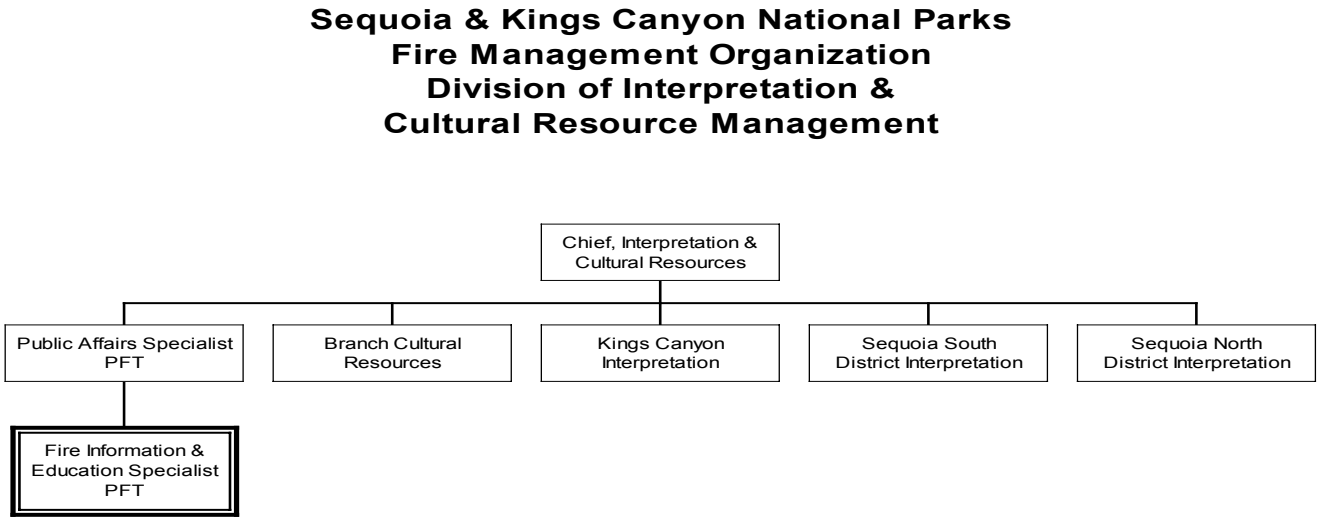
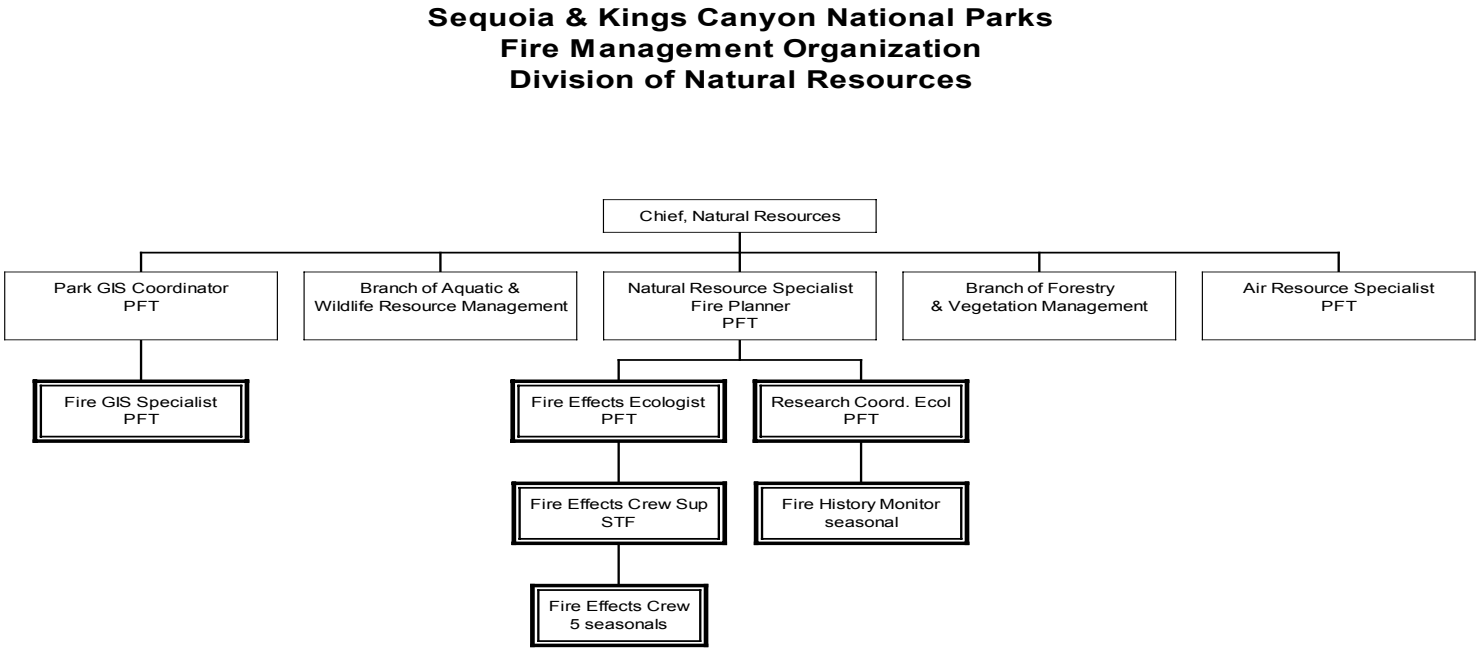


Figure G-6 – Organization Chart for Division of Natural Resources



H - List of Significant Cultural Resources

Table H-1 – List of Significant Cultural Resources (as of September 1998)

Barton-Lackey Cabin (#016) (Backcountry)	Gamblin Cabin (#350) (GG)
Chief Ranger's Residence (#108) (Grant Grove)	Smithsonian Institution Shelter (#354) (BC)
Old Superintendent's House (#112) (GG)	Old Market/Museum (#104) (GF)
Redwood Mountain Ranger Station (#115) (BC)	Residence #5 (AM)
Cedar Grove Ranger Station (#118) (Cedar Grove)	Residence #7 (AM)
Warehouse and Maintenance Shop (#237) (GG)	Residence #9 (AM)
Cedar Grove Storage Shed (#276) (CG)	Residence #12 (AM)
Redwood Mtn. Equipment Storage (#320) (BC)	Residence #14 (AM)
Chief Ranger's Horse Barn (#344) (GG)	Residence #15 (AM)
Muir Hut (#355) (BC)	Residence #29 (AM)
Knapp Cabin (#371) (CG)	Residence #64 (AM)
Cloud Canyon Shorty Lovelace Cabin (#18) (BC)	Residence #97 (AM)
Vidette Meadow Shorty Lovelace Cabin (#23) (BC)	Sycamore Village Store House (#140) (AM)
Gardiner Creek Shorty Lovelace Cabin (#24) (BC)	Sycamore Village Store House (#141) (AM)
Woods Creek Shorty Lovelace Cabin (#25) (BC)	Sycamore Village Recreational Hall (#142) (AM)
Granite Pass Shorty Lovelace Cabin (#27) (BC)	Syc. Village Tack and Hay Storage (#143) (AM)
Crystal Cave Trail ("F") (Crystal Cave)	Gas Station (#168) (AM)
Alles Cabin (#007A) (Mineral King)	Garage for Residence #97 (#289) (AM)
Ash Mountain Entrance Sign (#009) (AM)	Garage for Residence #5 (#292) (AM)
Lewis Camp Irrigation Canal (#011A) (BC)	Garage for Residence #9 (#295) (AM)
Tyndall Creek Shepherd's Cabin (#012) (BC)	Garage #296 (AM)
Moro Rock Stairway (#013) (GF)	Garage for Residence #12 (#298) (AM)
Clover Creek Bridge (#014) (Gens. Hwy.)	Garage for Residence #15 (#301) (AM)
Quinn Ranger Station (#033) (BC)	Garage for Residences #63 & #64 (#303) (AM)
Kern Canyon Ranger Station (#038) (BC)	Garage for Residences #77 & #78 (#304 (AM)
Tharp's Log (#044) (GF)	Garage for Residences #87 & #88 (#305) (AM)
Squatter's Cabin (#045) (GF)	Garage for Residences #90 & #91 (#306) (AM)
Cattle Cabin (#046) (GF)	Garage for Residences #92 & #100 (#307)(AM)
District Ranger's Residence (#055) (GF)	Garage for Residences #93 & #94 (#308) (AM)
Atwell Mill Ranger Station (#062) (MK)	Garage for Residence #95 (#310) (AM)
Cabin Creek Ranger Residence (#065) (BC)	Garage for Residence #96 (#311) (AM)
Cabin Ck. Dormitory and Garage (#066, #319) (BC)	Generals Highway ("B")
Hockett Meadow Ranger Station (#075) (BC)	Residential Area Rock Work ("C") (AM)
Residence 81 (Lodgepole)	Barrier Gate ("D") (Crystal Cave)
Residence 82 (LP)	Comfort Station & Generator (#199) (Crystal Cave)
Residence 85 (LP)	Tunnel Rock ("G") (Gens. Hwy.)
Residence 89 (Wolverton)	Automobile Watering Stations ("H") (Hosp. Rock)
Redwood Meadow Ranger Station (#102) (BC)	Colony Mill Road (#028) (GF)
Hockett Meadow Tack-Storage Room (#139) (BC)	Marble Fork Bridge (#029) (Gens. Hwy.)
Comfort Station (#179) (GF)	Hospital Rock Stone Steps ("I") (Gens. Hwy.)
Moro Rock Comfort Station (#200) (GF)	Hospital Rock Stone Water Fountain ("J") (GH)
Pear Lake Ski Hut (#204) (BC)	Silliman Creek Culvert ("K") (Gens. Hwy.)
Kern River Trail Bridge (#205) (BC)	Sawmill Site Ditches (Lewis Creek) (BC)
Redwd. Meadow Tack-Storage Cabin (#205A) (BC)	Residence #91 (AM)
Comfort Station #218 (LP)	Residence #95 (AM)
Comfort Station and Showers #219 (LP)	Residence #16 (AM)
Carpenter's Shop (#221) (LP)	Residence #17A (AM)
Lost Grove Comfort Station (#231) (Gens. Hwy.)	Residence #77 (AM)
Atwell Mill Ranger Station Garage (#315) (MK)	Residence #88 (AM)

Table H-2 – Mission 66 Buildings and Structures (pending Determinations of Eligibility)
This list involves any building or structure built as part of the "Mission 66 Program". These buildings date from the mid-to-late1960s.

Headquarters Building (Ash Mtn.)	Various Comfort Stations
Ash Mtn. Warehouse (Ash Mtn.)	Visitor Center (Lodgepole)
Fire Management Building (Ash Mtn.)	Visitor Center (Grant Grove)
Ash Mtn. Housing	Maintenance Building (Grant Grove)
Lodgepole Housing	
Grant Grove Housing	

Table H-3 – Ash Mountain Historic District (Proposed)
(NOTE: There is some overlap here with the LCS.)

Residence #5	Residence #12
Residence #7	Garage for Residence #12 (#298)
Garage for Residences #5 & #7 (#292)	Residence #14
Residence #9	Residence #15
Garage for Residence #9 (#295)	Garage for Residence #15 (#301)
Residence #16	Residence #29
Residence #64	Garage for Residence #29 (#302)
Garage #296	Residence (#97)
Garage for Residences #63 & #64 (#303)	Garage for Residence #12 (#289)

Table H-4 – Sycamore Historic District (Proposed)
(NOTE: There is overlap here with the LCS.)

Building #140 (Storehouse)	Building #142 (Recreation Hall)
Building #141 (Storehouse)	Building #143 (Tack/Hay Storage)

Table H-5 – General Grant National Park Historic District (Determined Eligible)
(NOTE: There is some overlap here with the LCS.)

Village Area Comfort Station	Comfort Station (Swale CG) (Bld. #250)
Village Area Service Station	Bath House (Swale CG) (Bld. #259)
Lodge Area Log Cabin	Comfort Station (Columbine Picnic Area) (Bld. #254)
Lodge Area Bath House	Comfort Station (Pine Camp) (Bld. #248)
Lodge Area Duplex Cabins (4)	Barn (Barn and Corral)
Lodge Area Tent Cabins (15)	Cabin (Barn and Coral)
Lodge Area Rustic Cabins (3)	Chief Ranger's House (Bld. #108)
Meadow Camp Cabins (24)	Superintendent's House (Bld. #112)
Old Maintenance Mess Hall (Bld. #111)	Garage (Bld. #322)
Old Maintenance Outbuilding (Bld. #243)	Woodshed (Bld. #245)
Old Maintenance Warehouse (Bld. #237)	Residence #113
Comfort Station (Crystal Springs CG) (Bld. #252)	Residence #114
Comfort Station (Azalea CG) (Bld. #257)	Garage for Residences #113 & #114 (Bld. #323)
Comfort Station (Sunset CG) (Bld. #249)	Residence #116
Bath House (Sunset CG) (Bld. #260)	Residence #117
	Generator (Bld. #209)

Table H-6 – Mineral King Road Cultural Landscape District (Determined Eligible)
(NOTE: There is some overlap here with the LCS.)

Mineral King Road (from Lookout Point to East MK) Lookout Pt. Ranger Residence Lookout Pt. Ranger Residence Garage Atwell Mill Ranger Residence (#062) Atwell Mill Ranger Residence Garage Slapjack Ck. Water Station Trough Trauger's Water Station Trough Redwood Ck. Water Station Trough	Cabin Cove Cabin Tract (1-5, 7) (n=6) West Mineral King Cabin Tract (2, 3, 5-7, 9-10, 12-15, 17-25, 27, 29-31, 33) (n= 25) East Mineral King Cabin Tract (1-3, 5, 7-8, 12, 14-17, 19-22, 25-26, 34, 36-38) (n=21)

Table H-7 – Kern Canyon Historic District (Proposed)
(NOTE: There is some overlap here with the LCS.)

Kern Ranger Station (HS #38) Kern Ranger Station Shower Kern River Trail Bridge (HS #10) Irrigation Canals (HS #11-A) Lewis Cabin Ruins (HS #11-B) Bedrock Mortar Site (SEKI 96-A-05)	Bedrock Mortar Site (SEKI 96-A-06) Lewis Camp Ruins Historic Site Contero Bridge Site Sawmill Site Irene's Camp Hockett Trail

I - Smoke Communication Strategy

The purpose of this communication strategy is to provide factual talking points about smoke that can be used during prescribed fires, fire use projects, suppression actions, and fires occurring outside the park. These points will be incorporated into various communication methods employed by the parks in reference to fire and fuels management (i.e. press releases, public meetings, interpretive programs, etc.). For more information on communication methods, please refer to the Public Information and Education section of Chapter 3 in this document and also the *Standard Operating Procedure for Fire and Fuels Information*.

The key to a successful strategy is targeting the right people (audiences) in the right ways (methods) with the right messages (talking points). During a fire incident, there are specific smoke messages that can be integrated into the general fire information effort.

AUDIENCES

1. Superintendent and Division Chiefs
2. All employees and their families (including NPS, SNHA, USGS, concessions, and volunteers)
3. Park Visitors (including in- park visitors, internet visitors, and special groups)
4. In- Park Communities – Wilsonia, Silver City, Mineral King cabins, Oriole Lake
5. Neighboring Communities – Three Rivers, Badger
6. San Joaquin Unified Air Pollution Control District

METHODS

During a Fire Incident

1. Clearly outline the authority given to park supervisors to minimize smoke impacts to their employees. Employees can notify supervisors if they are having adverse impacts from smoke. Alternative work schedules and locations will be arranged where appropriate.
2. Hold Open House/Town Meeting for employees and residents in smoke affected areas.
3. Operate particulate monitors in affected areas. Be prepared to move or add monitors. Start monitoring early in the incident.
4. Provide daily air quality information, which interprets the particulate monitor data.
5. Set up a smoke hotline (phone) to handle smoke complaints.
6. Leave flyers on employee doorsteps with tips to decrease exposure.
7. Post on bulletin boards.
8. Disperse information by email, voice- mail, and fax
9. Use the park webpage as a vehicle for dispersing daily air quality information.
10. Give air quality conditions during the daily weather report on park radio.

Year- round Actions

1. Incorporate air quality messages into year- round public outreach: interpretive programs, public meetings, press releases, etc.
2. Offer special air quality seminars or trainings to help locals understand regional air issues.

SMOKE TALKING POINTS

In addition to general fire messages/information, the following talking points on smoke should be included in public information. Each talking point includes an example of language that might be used in updates, press releases, articles, presentations, etc. The talking points are organized in groups according to when they will be used (i.e. specific times during the year or different types of incidents): Year- round, Early Fire Season, Announcing a Planned Smoke Event, Responding to an Unplanned Smoke Event, and During Long- Duration Smoke Event. These talking points can be seen "at- a- glance" in a chart at the end of this section.

Year- round

1. **Wildland fire smoke fits into a larger regional air quality situation.**

   Example: "The scenic vistas in the parks, especially in the summer, are highly obscured by regional haze. Haze is caused when sunlight encounters tiny particles in the air. These particles may be the result of either natural events or human activities. According to the local Air District, over 95% of the particulate pollution in our area originates from Central Valley sources (i.e. motor vehicles, industrial fuel burning, manufacturing, and agriculture). Less than 5% comes from wildland fire in the Sierra Nevada" (From SEKI's *"Fire & Fuels Management"* newspaper).

2. **Smoke, like fire, is a natural ecosystem component.**

   Example: "Is there a bright side to all this talk about smoke? While it is a health concern for humans, plants have adapted to live with smoke just as they have many other natural elements of the environment. Scientists are discovering that some plants might even depend on smoke for their survival. A scientific study looked specifically at the low elevation chaparral plant communities. In the laboratory, scientists exposed various seeds to heat and charring, as in a fire, and certain species remained dormant. When the same seeds were exposed to smoke, germination occurred. While some plants, like the giant sequoia, use heat from fires for seed dispersal, it now appears that other plants rely on smoke for germination" (From SEKI's *"Story of Fire"* newspaper, out of print).

Early Fire Season

3. **Park managers are sensitive to smoke impacts for visitors and employees.**

   Example: "The Sequoia and Kings Canyon fire and fuels management program is committed to balancing the needs of park resources and people. While fire has always been a natural part of this ecosystem, our current society presents unique conditions. Today, there

are more people than ever living near or visiting Sequoia and Kings Canyon. Every fire management action considers this fact when determining incident objectives."

4. **The parks work closely with the San Joaquin Valley Unified Air Pollution Control District to balance the fire and fuels management program with health and visibility issues.**

   Example: "The Air District is currently classified as "Serious Non- Attainment" for both ozone and PM- 10. To help the district achieve the National Ambient Air Quality Standards, Sequoia and Kings Canyon burns during optimal weather conditions, utilizes optimal ignition techniques, estimates project emissions, projects the anticipated smoke plume path, provides extensive public education/awareness, and coordinates with neighboring land management agencies and air districts."

5. **There are ways for park residents and neighbors to reduce their exposure to smoke.**

   Example: "Smoke concentrations can be avoided by following a few simple rules. Close windows, doors, and outside vents when it is smoky to prevent accumulations indoors. Run your air conditioner, if you have one. Keep the fresh air intake closed and keep the filter clean. Ventilate your home and work place during periods of little smoke. Avoid physical activities while smoke is dense. Paper masks are designed to trap large dust particles, not the tiny particles found in smoke. These masks will not protect your lungs from smoke."

   Example: "Residents of communities affected by smoke from wildland fires and prescribed fires are encouraged to practice good health habits. A healthy immune system is the best protection against the effects of smoke. Immune function is enhanced with regular moderate physical activity, good nutrition, hydration, and adequate rest" (From USDA Forest Service publication *Health Hazards of Smoke: Spring 2001*).

6. **Breathing smoke is not healthy for anyone, but some people are at greater risk.**

   Example: "People with heart or lung disease, such as congestive heart disease, chronic obstructive pulmonary disease, emphysema or asthma are at greater risk. Children and the elderly are also more susceptible to smoke. These people are advised to use caution and avoid physical activity while heavy smoke is present."

   Example: "The risks of occasional exposure to fine particulate and other components of vegetative smoke are minimal for healthy individuals. However, elevated levels of smoke that persist for months or years increase the risk of heart and respiratory disease, especially among the elderly and individuals with pre- existing respiratory or cardiovascular illness" (From USDA Forest Service publication *Health Hazards of Smoke: Spring 2001*).

7. **The *Air Quality Index* (AQI) is one tool that helps managers, employees, and visitors quantify daily air quality conditions.**

   Example: "Established by the Environmental Protection Agency and adopted by the states, the Air Quality Index (AQI) is a tool for reporting daily air quality conditions. Using numeric information from sensors like particulate monitors, the AQI tells you how clean or polluted your air is, and what associated health concerns you should be aware of. The AQI focuses on health effects that can happen within a few hours or days after breathing polluted air. You

can think of the AQI as a yardstick that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health danger. The Index identifies six conditions: good (0 to 50), moderate (51 to 100), unhealthy for sensitive groups (101 to 150), unhealthy (151 to 200), very unhealthy (201 to 300), and hazardous (over 300)." (Park Visitor Centers have wooden exhibits that display this information daily.)

Announcing a Planned Smoke Event

8. **During prescribed burns, fire managers utilize smoke management techniques.**

   Example: "The entire burn segment is 925 acres, but is split into two sections for smoke management reasons. A fire line has been constructed inside the segment where the fire can be held if smoke production is a problem. The burn boss plans to ignite 30- 40 acres per day to minimize smoke output. This will increase the duration of the smoke event but will decrease the ambient level of smoke at any one time."

9. **Due to the deliberate nature of prescribed fire, audiences can be notified prior to the smoke event about what to expect.**

   Example: "During the week of ignition, visitors traveling through the area will smell and possibly see smoke. Smoke will likely be visible from [specific location]. The smoke will most likely settle in lower elevations during the early morning."

10. **The park has the ability to monitor particulate levels in Sequoia and Kings Canyon National Parks during smoke events.**

    Example: "As soon as the park anticipates a smoke event with the ability to affect people, air quality technicians begin operating a Smoke and Weather Monitoring Module. This mobile unit measures particulate levels in the air. Particulates are solid particles produced by things like vehicle emissions, agricultural activities, and fires. The module records levels every hour and then computes a 24- hour average which correlates to the National Ambient Air Quality Standards (NAAQS) established by the Environmental Protection Agency (EPA). During extreme smoke conditions, technicians retrieve data from the module daily."

11. **Some characteristics of smoke accumulation are predictable because they are based on daytime and nighttime winds.**

    Example: "Up- slope or up- canyon breezes occur during the day which will often take smoke into higher elevations. At night, these winds change direction and bring smoke down- slope to the lower elevations."

12. **Some characteristics of smoke accumulation are not predictable since they are dependent on atmospheric conditions.**

    Example: "With unstable atmospheric conditions, smoke from wildland fires is mostly lofted up to very high elevations where it disperses. When atmospheric conditions are stable, perhaps with an inversion layer, smoke can be trapped at lower elevations.

Responding to an Unplanned Smoke Event

13. **Small natural fires have the potential to become large fires.**

Example: "Burning in heavy mixed conifer fuels, the newly discovered [*Name*] Fire has the potential to expand across hundreds of acres over the next several months. This fire was naturally- caused and will be naturally- extinguished with rain or snow. A "season- ending event" bringing more than ½- inch of rain over a 3- day period usually occurs in October."

14. **There are ways of minimizing smoke in a fire use project without suppressing the fire.**

    Example: "While the park hopes to maximize resource benefits by allowing this fire to spread naturally, managers have at least two ways of reducing smoke in special situations. Hand crews can install fire line in strategic locations to contain certain areas of the fire. In extreme smoke situations, fire managers can drop water on hotspots. Unlike water drops in suppression actions, these drops are not meant to halt fire movement, but slow it down and reduce smoke."

During Long- Duration Smoke Event

Use all of the talking points above and hold an open house/meeting to respond to community, public, and employee needs.

Table I-1 – Smoke Talking Points At-A-Glance

Year-round	Early Fire Season	Announcing a Planned Smoke Event	Responding to an Unplanned Smoke Event	During Long Duration Smoke Event
1.Wildland fire smoke fits into a larger regional air quality situation.	3. Park managers are sensitive to smoke impacts for visitors and employees.	8. During prescribed burns, fire managers utilize smoke management techniques.	13. Small natural fires have the potential to become large fires.	Hold an open house or a public meeting
2. Smoke, like fire, is a natural ecosystem component.	4. The parks work closely with the San Joaquin Valley Unified Air Pollution Control District to balance the fire and fuels management program with health and visibility.	9. Due to the deliberate nature of prescribed fire, audiences can be notified prior to the smoke event about what to expect.	14. There are ways of minimizing smoke in a fire use project without suppressing the fire.	
	5. There are ways for park residents and neighbors to reduce their exposure to smoke.	10. The park has the ability to monitor particulate levels in Sequoia & Kings Canyon National Parks during smoke events.		
	6. Breathing smoke is not healthy for anyone, but some people are at greater risk.	11. Some characteristics of smoke accumulation are predictable because they are based on daytime and nighttime winds.		
	7. The *Air Quality Index* (AQI) is one tool that helps managers, employees, and visitors quantify daily air quality conditions.	12. Some characteristics of smoke accumulation are not predictable since they are dependent on atmospheric conditions.		

OTHER SOURCES OF INFORMATION

1. Local Air District

2. Air Quality Specialist in the park

3. California Air Resources Board Public Education Protocol
   www.arb.ca.gov/smp/progdev/pubeduc/outreach_protocol.htm

4. National Interagency Fire Center – www.nifc.gov

5. Environmental Protection Agency – www.epa.gov/airlinks/

EXAMPLE OF MATERIALS

The following list identifies some possible materials for public use. Since most of them predate this *Smoke Communication Strategy*, they serve only as examples and are not templates for this document.

Do You Smell Smoke? or *Where there's fire there's smoke* – General description of where smoke is coming from and some simple steps for reducing exposure.

Smoke and Your Health – Questions and answers about wildland fire smoke and health.

Smoke Generated by Wildland Fires –Describes PM- 10, the Air Quality Index, and the use of particulate monitors. (example from SEKI)

NPS Using Portable Module for Smoke/Weather Monitoring –Describes the purpose and operation of mobile monitoring stations. (example from SEKI)

Getting a Handle on Smoke – Example of an interpretive article for park newspaper on smoke management techniques used in a prescribed fire. (From SEKI's *"Fire & Fuels Management"*)

Smoke Complaint Log – Sample sheet for cataloging smoke complaints during a fire event. (example from SEKI)

CASE STUDY

The recommendations contained in this *Smoke Communication Strategy* are based on experiences from the Hoover Complex of 2001 located in Yosemite National Park. While the strategy has now been tailored for Sequoia and Kings Canyon National Parks, the following information is retained as a case study in smoke communication.

Basic Incident Facts

- The Hoover Fire began with a lightning strike on July 4, 2001. As of September 4, 2001, the fire was 7,883 acres. Four small fires (Cold Creek, Kuna, Lyell, and Clark) were part of the larger Hoover Complex and totaled an additional 100 acres (approximately).
- At the same time as the Hoover Complex, other large fires were burning in the region near Coulterville and Oakhurst which contributed to the smoke problem.
- The presence of smoke in Yosemite Valley, El Portal, and Tuolumne Meadows for 14+ days became a major concern during this incident, especially for park employees and residents.
- Since fires in the Illilouette drainage are particularly troublesome for smoke in Yosemite Valley, the Interagency Fire Use Management Team implemented a plan which included the construction of fire line on the northwest section of the fire to prevent spread into that drainage.

Comments and Questions During the Hoover Complex

During the Hoover Complex, the park and the Incident Management Team received numerous comments and questions from employees and the public about smoke. In general, the comments and questions can be categorized into six groups. The exact questions and comments are listed below.

1) immediate and long- term health concerns
2) the need for tips to reduce exposure
3) work schedule/administrative issues for employees
4) the desire for park management to show concern
5) impacts on recreational activities
6) visibility

Employees

1. Health Impacts - Symptoms include: headaches, sore throat, sinus stuffiness, head congestion, heavy or labored breathing, increased asthmatic complications, watery and or red eyes, blurry vision, tiredness, burning sensation, irritated eyes, and loss of appetite.
2. "Are there any additional health hazards from short- term exposure to the higher levels of particulate matter in the air during portions of the work day?"
3. "Can employees use the CA- 1 to report smoke related problems?"
4. "Can employees work alternative work schedules?"
5. "If unable to work outside of the valley, or Tuolunme Meadows, what precautions can we take to minimize the continued impact of the smoke exposure?"
6. "Can employees go to the clinic during work hours?"
7. "Can air quality information be posted daily for employees?"
8. "Acknowledgement and concern for the situation from park leaders [would] certainly ease many of our minds."
9. "Fire is an important and necessary part of Yosemite and I support it whole heartedly, in fact we need more. The health of all employees and families here are also important and I would like very much to help, to learn how we can make this situation more user friendly or endurable for our park family."

Public

1. "The smoke from these fires has affected the Mammoth area and parts of Inyo National Forest. As a result, the air is polluted in these areas and has created respiratory and allergy problems for those of us that like to golf, fish, and hike."
2. "I know fire can be good for the forest at times…it can also cause many problems. I live in Mono County and have been enduring smoke, much of which is coming from your park. It has become difficult to breathe, our eyes are watering, and…many people are complaining of being sleepy all of the time due to the smoke. I would appreciate it if you would do the right thing by putting the fires out."
3. "The smoke over here on the east side is really bad. I have a small motel and people are leaving early. I notice that you are controlling one side of the fire so that the smoke in the valley doesn't get too bad. What about us over here? Is there any way to balance natural fire practices with some smoke suppression?"

Lessons Learned From Hoover Complex

1. The park needs to anticipate smoke events and distribute information before conditions deteriorate.
2. Involvement from park managers is crucial to communicating smoke messages.
3. Park supervisors need clear instructions about how to accommodate employees who are affected by smoke (alternative work schedules and locations, etc.).
4. Park employees, unlike visitors, worry about the effects of long term exposure to smoke since they are not a transient population.
5. Monitoring of air quality, particularly PM, is imperative and needs to begin early in the fire incident.
6. Smoke management is complicated when there is more than one large fire in the area.
7. While it is impossible to immediately extinguish a wildland fire when smoke exposure becomes a health risk, it is helpful for people to know that there are fire management techniques available that can reduce smoke in these situations (i.e. water drops, fire line construction).
8. It is reassuring for people to know that park management cares about their welfare.
9. Neighboring communities must be included when distributing smoke information.
10. Most people understand and support the general concept of fire use; actions to promote understanding are still necessary during smoke events.

J - Smoke Management Plan

SUMMARY

This *Smoke Management Plan* provides guidelines for park management of smoke from wildland fires. It addresses all requirements set by the San Joaquin Valley Unified Air Pollution Control District (hereinafter called the District).

The parks are within the San Joaquin Valley air basin. The basin is classified as serious non-attainment for two criteria pollutants (particulate matter [PM- 10] and ozone) as defined by the Federal Clean Air Act. This smoke management plan concentrates upon PM- 10 as the most significant pollutant produced by wildland fire thereby serving as a marker for other criteria pollutants.

Under the Clean Air Act and the California Air Resources Board (CARB) the District is required to implement Best Available Control Measures (BACM) in order to meet established deadlines set for complying with PM- 10 National Ambient Air Quality Standards (NAAQS). BACM is implemented in the air basin by requiring the parks' fire program, and other burners within the air basin, to comply with a series of emission control measures that are some of the most stringent in the nation.

The District has developed its own *Smoke Management Plan* for regulating fire use projects and prescribed fires. The park *Smoke Management Plan* implements the District plan. In addition, the district has two specific rules pertaining to fire use projects and prescribed fires, Rule 3160 (Prescribed Burning Fee) and Rule 4106 (Prescribed Burning and Hazard Reduction Burning). This *Smoke Management Plan* responds to District procedures and rules contained in their plan. The dynamic nature of air resource management may require annual adjustment to this *Smoke Management Plan*.

The parks are part of an interagency group of wildland fire burners (federal, state, and private) and the District which meets quarterly to discuss and seek improvement to basin air quality through improvements in fuels management and associated effects to the air resource. As a group member, the park adheres to all District rules described above plus actively pursues completion of a memorandum of understanding (MOU) between the District and the eight state and federal agencies that conduct prescribed burning or manage fire use projects within the air basin. The MOU will establish a cooperative relationship between the wildland burners and provide a framework to interact with the District on air quality issues.

By carefully managing the timing and location of smoke emissions these parks can meet goals in the *Fire and Fuels Management Plan* and the District's plan while treating up to 15,000 acres per year of park land. As natural areas are treated and maintained with prescribed fire, fire use projects, and mechanical treatments, the potential amount of smoke emissions will be reduced. Smoke emissions that would otherwise be released during unwanted wildland fire events with accompanying severe smoke impacts to smoke sensitive areas (SSA's), potential harm to life and property, and unnatural alteration of ecosystems will be reduced.

INTRODUCTION TO THE SMOKE MANAGEMENT PLAN

Smoke behavior, and corresponding impacts, is a complex issue involving a number of elements:

- Fuel reduction techniques prior to or instead of burning as a means of emission reduction.
- Amount of fuel loading that will burn.
- Restoration areas have the highest fuel loading, including duff, which mostly burns in the smoldering phase. Maintenance areas have less fuel per acre than restoration areas (including duff loading) leading to a shorter, more discontinuous smoldering phase.
- Location, amount and duration of smoke emissions.
- Type of fire situation and controllability.
- Prescribed burn operations are more controllable and predictable than fire use projects. Generally, large unwanted suppression fires are the most uncontrollable and least predictable.
- Time of year smoke is produced.
- Summer conditions often provide the best southwesterly flow and lift for smoke but ozone levels are higher. Spring conditions provide weather events to disperse smoke but fuels are often too wet to burn. Fall conditions provide an excellent window for fuel and fire manageability but weather conditions often do not yield good smoke dispersal conditions.
- Behavior of the smoke plume, which is dependent on elevation and dynamic meteorological conditions.
- Direction and elevation the plume moves and resulting impacts at ground level to people, and impacts to sensitive airsheds, such as wilderness.
- Interaction of smoke from park fires with pollution sources in the San Joaquin valley (including other fires in the area).

This plan will be used to provide direction for the parks smoke management program. The plan directly parallels BACM as mandated by the EPA, CARB, and the District. The plan is based on smoke management principals provided by the national fire management training Smoke Management Techniques, RX- 450. Written and verbal procedures that implement this plan will be revised continually as new or better methods become available, along with adjustments in staffing and support needs.

The current park smoke management program is probably the most advanced and complex in the nation. The purpose of the program is to serve the goals and objectives of the park *Fire and Fuels Management Plan* while, at the same time, serve the requirements of the Federal Clean Air Act as enforced by CARB through the District. The District was declared a serious non-attainment area for PM10 in 1993. Park fire staff, along with representatives from several land management agencies, worked closely with the District in development of the 1994 Serious Non- attainment Area PM10 Plan. The PM10 Plan called for the implementation of BACM for particulates via an earlier MOU and accompanying work plan signed by the park in 1997.

In 1999, revision to CARB Title 17 forced required changes in District rules. Rule 3160 and 4106, as well as the District *Smoke Management Plan*, arose due to the new Title 17 direction. Rule 3160 describes procedures for assessing fees against acres treated with fire in order to fund District meteorologists and enforcement staff for prescribed fire regulation. Rule 4106 details

regulations for permitting, regulating, and coordinating prescribed fire and fire use projects within the District area. The District then declared the 1997 MOU and its work plan void following the rule revisions in 2001. Wildland burners in the air basin subsequently restated their desire to revisit and recreate an MOU as a method to insure coordination amongst burners with the District. That MOU is now in development. Upon completion, it will become an Addendum to the parks' *Fire and Fuels Management Plan*.

Much of this S*moke Management Plan* details smoke management techniques and administrative procedures. It is recognized that there exists a large amount of potential smoke emissions within the District due to the past 100 years of land management practices in natural areas. Where lands remain far outside the normal fire regime, unnatural ecosystem structure and processes predominate leading to high fuel accumulations and continuous canopies of vegetation. District staff recognizes these conditions exist and require attention. This plan and District rules and regulations are meant to balance ecosystem needs and air resource needs in order to stabilize ecosystems and reduce the amount of potential emissions over a multi- decade period of time.

REQUIRED DAILY MONITORING

A permanent particulate monitor is stationed at Ash Mountain headquarters in Sequoia National Park, near the most populated SSA impacted by park fires, the town of Three Rivers. The monitor is located at the Ash Mountain air quality station. Data is collected 365 days per year and catalogued into a database so that baseline particulate loading is produced. Particulate loading for each date can then be compared with historical averages aiding fire managers in comparing current conditions with historical conditions as an aid in prescribed fire treatment and fire use execution. Seven years of data now exist in the database.

The park has been visually monitoring the impact of transport smoke that flows over the eastern crest into the Owens Valley via the Inyo National Forest since 1996. A catalogue of visibility photos taken looking west towards the Sierra crest for each date in fire season exists on file at Ash Mountain fire management headquarters.

PRESCRIBED FIRE

Planning: What do we do?

- **Annually identify areas** that need prescribed fire and/or mechanical treatments by evaluating values, hazards, and risks for the three Zones and nine Fire Management Units (FMUs).

- **Select treatment priorities** based upon the analysis of the values, hazards, and risks. Consider managerial capabilities to accomplish treatments given practical limitations in planning, finance, operations, and logistical support.

- **Write the annual fuels treatment plan** that describes the program for the up- coming field season including descriptions of individual treatment preparation and execution needs.

Insert this annual plan into a revised 5- *Year Fuels Treatment Plan*. Burns will be dispersed across the parks in order to spread smoke emissions out over as broad an area as possible. Some areas of the park may not have prescribed burns take place every year in order to provide a break from smoke impacting SSA's.

- **Submit the annual fuels treatment plan to the District for review**. Note that air quality regulations and requirements are dynamic and subject to change. The process described below is in effect at the time of this document's publication. Updated procedures and requirements enacted after the approval date of this plan will be incorporated in annual updates to the *Fire and Fuels Management Plan*. While the District does not have authority to approve or reject this overall *Fuels Treatment Plan*, it does provide input to the individual prescribed fire burn plan. Air quality concerns remain the major issue affecting prescribed fire treatment.

- **Submit the burn plan to the District for review under Rule 4106.** The Air District has up to 30 days to review individual burn plans. They are required to inform the parks of concurrence or to request changes at the end of the 30- day period. Burn plans will describe the smoke management parameters necessary to provide optimum smoke dispersal based on burn goals and objectives, location, fuel loading and predicted fuels consumption, length of ignition and burn down, and proximity to SSA's. Burn plan contingencies will also include a description of the decision process park management will take to limit smoke impacts if smoke conditions deteriorate in SSA's and the coordination requirements with the District. Minimum safe roadway visibility is described and the mechanism for maintaining safe use of the roads is explained in detail.

- **Complete the District smoke management plan and submit with the burn plan.** The District uses their smoke management plan to permit burns. The smoke management plan for the burn can reference the burn plan. Smoke management plans will also describe alternatives considered in lieu of burning and earlier treatments employed which have all ready reduced potential emissions. Discussion will provide why alternatives were rejected and how earlier treatments have provided mitigation for current burning.

- **Request pre- ignition forecast.** No more than seven days prior to the earliest ignition date, a request will be submitted to the District to begin long- range smoke dispersal forecasting for the proposed ignition (CB3 forecasts). The District will provide 96- , 72- , and 48- hour outlooks, and 24- hour forecasts on days leading up to the proposed ignition date. The District retains final go/no- go authority until the time of ignition.

Project Implementation: What do we do?

- **Monitor weather and fuels** against prescriptive criteria. Prescribed burns are ignited when weather conditions are favorable for dispersing smoke away from SSA's, or during conditions that dilute smoke so that impacts to SSA's do not exceed health standards. This will be accomplished by utilizing the most current and comprehensive weather forecasting information available for predicting smoke transport direction and concentration down wind. Fuel moisture is also a high priority prescription element that will be monitored pre- burn. Fuel moisture prescriptions are designed to provide the optimum balance between the need to

moderate fire behavior, minimize undesired fire effects on other resource values, and minimize smoke production (drier fuels burn cleaner and produce less pollutants). Fuel moisture information will be obtained and analyzed pre- burn for all significant categories of fuels (litter/duff, 1- , 10- , 100- and 1000- hour fuels) to ensure conformity with the prescription.

- **Obtain superintendent go/no go decision** on ignition.
- **Seek concurrence from the Air District** to proceed with ignition.
- **Notify the public** about the ignition.
- **Hold briefing** and review burn plan operations with burn staff.
- **Ignite a test- fire.**
- **Make final go/no go decision on ignition** (burn boss and associates).
- **Ignition occurs**. Fire Management staff will proactively regulate the number of acres burned each day. Two factors are of critical importance: emissions produced per day and duration of smoke produced. For prescribed fire treatments of forested areas near SSA's, acreage treated in restoration burns may be limited to about 50 acres per day, with twice that acreage for maintenance treatments. This limit serves only as a guide with acreage treated varying due to terrain, proximity to SSA's, fuel conditions (i.e. loading, dryness, fuel model), meteorological conditions, etc. Duration of smoke produced from fires will vary with the fuel type. Timber fires, due to fuel loading inclusive of duff, burn for the longest time periods. With half the duff present on most maintenance burns, duration is significantly reduced. Again, as a general rule, smoke production near SSA's should be kept to less than 5 days before significant reduction in particulate load production occurs.
- **Monitoring of meteorology and air quality conditions will begin prior to ignition and follow through ignition completion and burn down of remaining available fuels.** Qualified fire personnel will conduct all smoke monitoring. Personnel will monitor smoke impacts to SSA's and transmit that information to the burn boss to utilize the intelligence gathered to adapt burn execution to avoid unhealthful smoke impacts. This will be accomplished by visual observations on small fires, short duration fires (e.g. grass fires) and on remote wilderness fires. On fires in close proximity to SSA's, that may be of long duration or possess heavy fuel loading, monitoring will include equipment to measure particulate load production, collect 24 hour weather data, and document visibility conditions through photography.
- **Dispersion Intelligence.** Smoke dispersion potential (the capacity of the atmosphere to absorb and disperse smoke) is carefully evaluated prior to a burn being ignited and during unit execution. Several methods can be utilized:
  - Park fire management personnel operate 6 weather stations spread across the parks. The weather data collected provides fire staff with current information used in fire operations planning.

- Standard National Weather Service fire weather forecasts are reviewed for favorable dispersal winds aloft. Generally, ridge winds from the west at 10 to 15 mph are desirable.
- Data provided by various Internet sources provide detailed information on regional weather trends.
- Pre- fire spot weather forecasts provided by the Weather Service provide detailed smoke dispersal information. Predicted unstable atmospheric conditions are optimal, although fire managers must weigh instability against the ability of fire behavior to become erratic and escape.
- The District's meteorologists provide additional dispersal information for burns at all elevations.
- Release of PIBAL balloons may be used to determine surface and low level wind speed and direction before and during burn ignition and burn down.
- The park contract helicopter can be used to assess the atmospheric adiabatic lapse rate before and during burn unit execution- - which helps with interpreting the capacity of the atmosphere to disperse smoke. Helicopter crew members also conduct visual observations of burn unit smoke dispersal and record the observations.
- Significant test fires will be conducted prior unit ignition to determine that burning goals and objectives will be met, and that smoke dispersion occurs as predicted in the burn plan.

Post- fire: What do we do?

- **Assemble monitoring data** as part of the final fire package.

- **For fires larger than 250 acres, complete District smoke management plan post fire summary report.**

- **By May of following year, pay District $5.00/acre for all black acres produced on burn.**

Staffing Needs and Responsibilities

The District fire management officers are responsible for the implementation of the annual fuels treatment program within their respective areas. Working with the park fuels specialist, district fire management officers will assign burn bosses to individual burn units, who must ensure appropriate staff is assigned to each burn. District fire management officers will ensure coordination occurs between the District and the burn boss. Fire and aviation dispatch will track all CB3 and spot fire weather forecasts, and serve as an information gatekeeper when burn bosses are assigned and unavailable for telephone conversations with District enforcement staff. The park fuels specialists will act as the check in the system ensuring coordination at the burn plan/smoke management plan phase, execution phase, and post- fire stage occurs.

Documentation and Cost Tracking

The fire folder will contain copies of all documents as outlined in Appendix Q (Wildland and Fuels Management Reporting Requirements). The folder will include: all planning documents (burn plan and any amendments, smoke management plan, incident action plans), monitoring data and summary reports, fire time reports, maps, photos, and DI- 1202. All expenditures will be

tracked and reported according to the standards established in the Department of the Interior Individual Fire Occurrence Form (DI- 1202). It is the responsibility of the district fire management officer, or his/her burn boss, to ensure fire report completion. Acres blackened rather than fire perimeter will be used to assess District Burn fees.

WILDLAND FIRE USE

Planning: What do we do?

When a fire is reported, the parks will take the following actions:

- **Locate the fire**.
- **Size up and determine cause**.
- **Complete a WFIP Stage I analysis** to determine the appropriate management response with two hours of fire confirmation. Share stage 1 with the District.
- **Decision criteria and risk factors to consider** in the stage I analysis are outlined in Chapter 4 of the Wildland and Prescribed Fire Management Policy Implementation Procedures Reference Guide (Addendum). Parameters requiring in- depth analysis for the parks will include air quality for those fires with potential to affect SSA's. If it is determined that the fire can be managed within the constraints outlined, the ignition may be appropriate to manage as a fire use project.
- **Receive approval from the District** to manage the fire as a fire use project on the day ignition is confirmed.
- **Implement the appropriate management response**. For fire use projects this may vary from periodic aerial reconnaissance to on- scene fire monitors. If the management complexity of the fire exceeds the capabilities of local resources, the parks may manage the incident through delegation to a fire use incident management team (see Appendix K for a delegation of authority example).
- **For fires exceeding 10 acres, complete the District smoke management plan.** This plan is the same as outlined for prescribed burns. Typically, the District receives a Stage II WFIP and the smoke management plan at the same time. Most often, smoke management plans are not needed for those fires requiring only a Stage I WFIP because they stay less than 10 acres in size.
- **Continue to reassess the fire situation.** The park must perform periodic fire assessments. The superintendent must continually validate that the fire is managed appropriately and will assess if there is a need for a more detailed Stage II or III WFIP analysis, or for conversion of the fire use project to a wildland fire suppression action. If air quality drives the need for Stage II or III analysis, detailed information on mitigation for air quality effects will be

contained in the WFIP, and cross referenced to the smoke management plan for the fire use project.

- **Manage the fire until declare dead out** according to monitoring intensity and frequency guidelines indicated in the WFIP. At the minimum, periodic ground or aerial reconnaissance will be used to verify the periodic revalidation of the fire use response. More in- depth monitoring may be necessary to ensure proper incident management if complexity or risk increases. The parks monitor for wind speed, wind direction, smoke plume rise and dispersal, temperature, humidity, fuel moisture, fire size, and fire behavior (rate of spread, direction of spread, intensity).

Post- fire: What do we do?

- **Assemble monitoring data** as part of the final fire package.

- **For fires larger than 250 acres, complete District smoke management plan post fire summary report.**

- **By May of following year, pay District $5.00/acre for all black acres produced on burn.**

Staffing Needs and Responsibilities

Stage I through III analyses will be completed by district fire management officers or their designates (park fire management officer or fuels specialist staff) with input from the park fire planner or his/her designate. Additional park staff serving as subject matter experts will be involved in planning as conditions, issues, and fire location dictate. Examples include: district rangers, air quality specialist, archeologist, wildlife biologist, roads and trails supervisor, district facility manager, and fire information and education specialist. Fire complexity and risk will determine staffing needs.

Documentation and Cost Tracking

The fire folder will contain copies of all documents as outlined in Appendix Q (Wildland and Fuels Management Reporting Requirements). The folder will include: all planning documents (burn plan and any amendments, smoke management plan, incident action plans), monitoring data and summary reports, fire time reports, maps, photos, and DI- 1202. All expenditures will be tracked and reported according to the standards established in the Department of the Interior Individual Fire Occurrence Form (DI- 1202). It is the responsibility of the district fire management officer, or his/her burn boss to ensure fire report completion. Acres blackened rather than fire perimeter will be used to assess District Burn fees.

BURN PLANNING, ADMINISTRATION AND AUTHORIZATION

Fire and Fuels Management Plan. The park's *Fire and Fuels Management Plan* is the primary controlling document that implements NPS fire policy and direction for the fire management

program. The plan implements the intent of Director's Order (DO)- 18, the National Park Service's wildland fire management guideline.

Annual Fuels Treatment Program. An annual Fuels Treatment Program document is completed each year after extensive internal discussions are conducted throughout the parks involving personnel from several park functional divisions. Interagency planning for joint, cooperative burn projects is also completed during the winter and reflected in the annual plan. The annual plan is reviewed by the Fire Management Committee and approved by the Superintendent.

Fuels Treatment Planning. Prescribed burns are planned over a broad area to allow projects to be executed during optimum burning conditions throughout the fire season depending on goals and objectives, location, elevation, aspect, fuel type and proximity to SSA's. Mechanical plans and follow- up burning of mechanical fuels are confined to smaller areas associated with maintenance of defensible spaces surrounding structures or communities. Many burns take place above 6,000 feet elevation. All prescribed burn operations must comply with standard park burning prescriptions that include fuel moisture and environmental conditions.

Responsible Park Officials. The Superintendent is responsible for all government activities occurring on parklands, and approves the fuels treatment plans and fire use projects. He/she has full authority to act on any fire situation occurring on parklands. The Chief Ranger is supervised by the Superintendent and is responsible for park fire management. The park Fire Management Officer reports to the Chief Ranger, and oversees the planning and operations of park programs relating to fire and aviation management.

RESPONSIBLE PERSONNEL, ORGANIZATION & QUALIFICATIONS

Qualification System. Park Fire Management staff implement DO- 18 training and qualifications standards by assuring that fire management personnel are trained and qualified by following the National Incident Qualification and Certification System. The staff works to assure that adequate numbers of qualified personnel are available to conduct prescribed fire and wildland fire operations. Personnel are qualified in the following positions:

- Prescribed Fire Manager - oversees prescribed fire operations program implementation and is supervised by the district fire management officer or his designate.

- Prescribed Fire Burn Boss - is responsible for on the ground execution of individual prescribed burns. May be supervised by the Prescribed Fire Manager or district fire management officer (if prescribed fire manager is not needed).

- Prescribed Fire Ignition Specialist - is responsible for burn unit ignition and is supervised by the burn boss.

- Prescribed Fire Behavior Analyst - is responsible for analyzing potential fire behavior and is supervised by the prescribed fire manager or burn boss depending on incident complexity and need for the position.

- Prescribed Fire Monitor - is responsible for fire monitoring and is supervised by the burn boss and is responsible for gathering data about fire weather conditions, fire behavior and fire spread and relaying the information to burn incident personnel.

- Firing and holding personnel are supervised by the burn boss and are responsible for igniting the burn segment and holding the fire within established fire lines.

- Fire Use Manager - oversees fire use program implementation and is supervised by the district fire management officer or his designate.

- Incident Commander - is responsible for on the ground execution of individual fire use projects. May be supervised by the Fire Use Manager or district fire management officer (if fire use manager is not needed).

INFORMATION AND AWARENESS

Information about smoke events is distributed to target audiences in accordance with the Public Information and Education section of Chapter 3 in the *Fire and Fuels Management Plan* and the *Standard Operating Procedures for Distributing Fire Information* (Lyle 2002). The latter document contains specific checklists, fax numbers, email lists, community contacts, etc. The Smoke Communication Strategy (Appendix I) provides specific talking points about smoke.

Smoke Complaints Management. Visitor centers and dispatch centers use the *Smoke Information/Complaint Form* to record visitor and employee concerns about fire operations. Information from these forms is immediately transferred to fire managers so that formal complaints can be communicated to the local air district. The forms are collected by the Fire Information Officer and evaluated for special information or outreach needs.

MONITORING AND COMPLIANCE / ENFORCEMENT

On Site. Smoke monitoring is done on all burns by qualified fire personnel. They monitor smoke impacts to Smoke Sensitive Areas and utilize the intelligence gathered to adapt burn execution to avoid unhealthful smoke impacts. This is accomplished by visual observations and by use of a state- of- the- art mobile monitor called the Smoke and Weather Monitoring Module when indicated. When used the module is set- up in Smoke Sensitive Areas during nearby burn unit execution. The module records particulate and carbon monoxide concentrations, weather conditions and visibility with a time lapse camera. Park fire staff have a second mobile particulate monitor and several mobile automated weather stations. A permanent particulate monitor is located at Ash Mountain headquarters near the most populated Smoke Sensitive Area impacted by park prescribed burns—the town of Three Rivers.

Off Site. The park has been visually monitoring the impact of transport smoke that flows over the eastern crest into the Owens Valley region with the US Forest Service since 1996.

The park contract helicopter can be used to conduct visual observations of burn unit smoke dispersal and helicopter crew members record the observations.

Burn Execution Regulation. Individual burn plan smoke management contingencies include a description of the decision process park management will take to limit smoke impacts if smoke conditions deteriorate in SSA's, and are designed to provide outreach to communities impacted by unpredicted smoke or unhealthful smoke impacts.

Notification and coordination with affected air districts occurs on a daily basis throughout the fire season. If there are smoke caused complications during the execution of a fire incident, the affected air district(s) will be notified by phone as soon as practical. A follow up submittal will be required by the District within 10 days after the initial notification before additional prescribed burn units can be executed.

EMISSION INVENTORY

A Fire Management Smoke Emissions Inventory was completed April 19, 1996 per instructions provided by the District for the period 1985 to 1994 and includes projected program through 2010. Annual tracking of actual smoke emissions will be accomplished for prescribed burns that are executed during the previous season. PFIRS may tract and display emissions information for the various agencies and air district staff to use as needed.

EMISSION REDUCTION TECHNIQUES

Burning Prescriptions. All prescribed burns must comply with standard park burning prescriptions that include fuel moisture and environmental conditions.

Mechanical Reduction Potential. About 98% of parklands are administered as natural areas with about 85% of parklands managed as designated Wilderness. Mechanical techniques to reduce fuel load prior to prescribed burning is therefore limited by law and administrative policy to only the park developed areas. Mechanical fuel reduction is limited to areas immediately adjacent to developments in order to provide protection of structures or infrastructure from unwanted, damaging fire events.

Fuel Moisture. The primary emission reduction techniques used in park prescribed fire operations is to burn forest floor fuels under the "cool" end of the burning prescription, while still meeting burn unit goals, in order to limit the amount of available fuel that burns, thereby reducing overall emissions. Grass and brush fuel types are burned in the "warm" end of the prescriptions in order to produce a cleaner burn- - moist grass and brush produces more emissions since the entire plant is consumed by the fire.

STATE OVERSIGHT

The California Air Resources Board (CARB), as the state air regulatory agency, has the authority to enforce all provisions of the smoke management program through the State Implementation Plan.

K - Delegation of Authority Example

Date: October 2, 2003

Memorandum

To: Wayne Cook, Incident Commander

From: Superintendent, Sequoia and Kings Canyon National Parks

Subject: Kaweah Kern Complex Delegation of Authority

The Superintendent of Sequoia and Kings Canyon National Parks (SEKI) is responsible for ensuring the protection of park resources and the lives of park visitors and employees. The Superintendent must also act responsibly in dealing with park neighbors. Your expertise in wildland fire management will assist in fulfilling these responsibilities.

Your team's actions will be guided by National Park Service fire management policy, and Office of Aircraft Services aviation policy. In addition, the incident will be managed in accordance with the goals and objectives identified in the SEKI Fire Management Plan. To help communicate such policy so that your fire management efforts are successful, we are providing guidelines below:

1. You will have management responsibility for the following wildland fire use and suppression fires: Paradise 2 (containment action), Homers Nose 2 (containment action), Slide Bluffs, Frypan, Williams, West Clover, Giant, East Fork, West Kern, and Soda Springs fire use fires. Stage 3 wildland fire implementation plans have been prepared for the Williams, West Kern, and Giant fires. Stage 1 and 2 analyses have been prepared for the remaining fire use fires. Wildland fire situation analyses have also been prepared for Paradise 2 and Homers Nose 2. These documents will serve as guidance for management actions.

2. The safety of fire personnel, the public, and our employees is the highest priority during all phases of the incident. It is also important to minimize area closures, to the extent that this does not compromise human safety. To date, we have the following area closures and trail closures in effect: Coyote Creek trail from the Kern Canyon Ranger Station west to the park boundary. Numerous trails in Giant Forest. An area closure surrounding the Williams Fire inclusive of 3 trails. The Sequoia Park and Kings Canyon district rangers are charged with trails management. They will be consulted regarding changes to trail closures.

3. You will be operating within Wilderness. Environmental impacts from fire management actions are of greater concern than the total number of acres burned. If holding actions must be executed, please use minimum impact suppression tactics (MIST) commensurate with the resource. For example: 1) foam is kept clear of stream channels,

2) fire lines should not be constructed directly through meadows, and 3) all fire lines will be rehabilitated according to agency policy (approved by the Resource Advisor).

4. The West Kern fire is very near the Kern River Ranger Station. Special consideration must be given to the safety and protection of the backcountry ranger and two additional people living at the cabin, the nearby private property on the Inyo National Forest, and cultural resources in the area. Please follow the pre- planned *Kern Structure Protection Plan*. This plan was approved by SEKI fire management, and SEKI cultural resource advisors.

5. The Giant fire is in Sequoia National Park's Giant Forest. Special consideration must be given to the safety and protection of visitors to the Giant Forest area given the high rates of visitor use. Please refrain from helicopter overflights of the fire unless aggressive holding actions are required to limit fire spread. Also, trees of special significance, such as the Washington tree are in the fire's perimeter. Consult with the agency representative regarding appropriate actions adjacent to such trees.

6. Work with park public information staffs to keep park concessionaires, park and forest visitors, employees, cooperators, and neighbors fully informed of your incident team's actions and decisions. Please give us the opportunity to review written materials pertaining to our units before dissemination. In addition, excellent educational opportunities exist on the Giant Fire. Please work with the parks' fire information and education specialist to ensure these opportunities are met.

7. The remote nature of many of the fires coupled with economic efficiency has led to spike camps. Please see that the assigned resources are dispersed in order to minimize impacts to natural and cultural resources. Proper food storage procedures must be followed at all backcountry locations due to black bear activity.

8. Manage costs commensurate with resource values affected.

9. All of the fires are within the boundary of the San Joaquin Valley Unified Air Pollution Control District. You must work with the parks fire management staff on daily coordination with the Air District. Statewide conference call procedures exist to help with the process.

10. The Ash Mountain conference room will serve as your ICP location. Helicopter operations can be managed out of the Ash Mountain helibase or nearby private property with the input of the parks' agency representative.

11. All press releases will be coordinated and reviewed by the Agency Representative for Sequoia and Kings Canyon National Parks.

12. The parks retain initial attack and fire size up responsibilities. We will keep you fully informed of our fire response, especially for those fires located within maximum manageable areas you are managing for the parks so that employee safety is not compromised. Should initial attack actions fail, we will consult you on extended attack.

13. Many of our personnel are assigned to the complex. Please work with the Agency Representative on coordinating use of park resources for the benefit of our initial attack success and for trainee opportunities for our employees.

SEKI Park Contacts:

- **Agency Representative** – David Allen, Sequoia District Fire Management Officer (559) 565- 3162.
- **Resource Advisor** – Tony Caprio, Natural Resources Specialist (559) 565- 3126
- **Cultural Resource Advisor** – Tom Burge, Cultural Resource Specialist (559) 565- 3139
- **Fire Information** – Jody Lyle, Fire Information and Education Specialist, (559) 565- 3703

As of 1800 on October 2, 2003, we are delegating to you the authority to manage the Kaweah Kern Complex. This delegation will remain in effect until the parks receive a return memorandum from you turning authority for management of the fires back to the park.

Richard H. Martin, Superintendent

L - Fire Crew Readiness Review

Crew Designator: _____

List Highest Crew Qualifications – Does the crew meet minimum qualifications? Yes No

Name	Highest Qualification
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Have all crew members attended annual wildland fire safety refresher? Yes No

Have all crew members passed arduous duty medical examinations that meet three- year currency requirements? Yes No

Have all crew members passed the annual pack test? Yes No

Comments:

_____

_____

_____

I have reviewed the crew's qualifications and certify the crew is available for wildland fire assignment.

Reviewed by: _____ Date: _____
Crew Leader

Concurred by: _____ Date:_____
SEKI Fire Management Officer

M - Fire Use Restrictions and Emergency Closure Plan

INTRODUCTION

Enforceable fire use restrictions and emergency closures can reduce the possibility of human caused wildfires occurring during periods of seasonal drought, when wildfires can cause serious damage to park resources and threaten the safety of park visitors and employees. It is highly unlikely that park areas would need to be closed to public entry because of fire danger reasons alone although it could become necessary if there is substantial fire activity in the area and park staff decide that new fire starts must be prevented. Emergency closures for public safety reasons are also made during most fire seasons for certain park areas affected by fire operations.

OBJECTIVES

A. To restrict the use of fire by the public in defined areas of the parks during periods of high, very high, and extreme fire danger.

B. To provide park administrative staff with a procedure for making emergency closures for fire prevention and public safety reasons.

C. To make fire use restrictions and emergency closures that comply with the requirements set forth in 36 Code of Federal Regulations, Part 1, section 1.5.

AUTHORITY

Fire use restrictions and emergency closures shall be made in compliance with the requirements set forth in 36 Code of Federal Regulations (CFR), sections 1.5 and 2.13(c). For enforcing fire use restrictions this plan serves as the written determination required in section 1.5 (c). Decision memorandum will be approved by the superintendent when fire use restrictions are enforced. For enforcing emergency closures for fire prevention or public safety reasons, a Special Order will need to be approved by the park superintendent and given wide distribution. Whenever fire use restrictions or area closures are enforced public notice must be given in compliance with 36 CFR, section 1.7.

PROCEDURE FOR ENFORCEMENT OF FIRE USE RESTRICTIONS

The Fire Management Officer shall have the responsibility to identify areas of the parks where fire use restrictions and emergency closures for fire prevention purposes should be implemented. The Fire Management Officer will consider:

- Weather data
- Fuels data
- Visitor use trends
- On- park fire situation (Number of going fires and their potential, probability of new starts, and on- park suppression resource draw- down)
- Current adjoining National Forest fire use restriction and emergency closure
- enforcement- - SQF, SNF, INF
- Regional and national preparedness plan levels

The Fire Management Officer will consult with the Kings and Sequoia District Rangers.

The Fire Management Officer will recommend to the Chief Ranger and Superintendent the appropriate Stage Level that should go in to effect. A decision memorandum will be approved by the Superintendent.

Once restrictions have been approved the Fire Management Officer will coordinate the following in order to place Stage I, Stage II or Stage III restrictions/closures into effect:

1. Work with the Park Public Information Officer and issue a press release announcing the Stage Level.
2. Notification of all park visitor center information desk personnel.
3. Notification of all park District and Sub- District Rangers.
4. Coordinate the placing of signs (see Stage I, Stage II, and Stage III signing below).
5. Make available to all visitor centers a fire use restriction and emergency closure handout for the public and employees.
6. Request that Park Dispatch announce daily the current Stage Level during the morning report broadcast, and put Stage Level information in the written morning report.
7. Notification of Fire Dispatchers at Inyo, Sierra, and Sequoia National Forests, and Tulare and Fresno Ranger Units—California Department of Forestry.
8. Notification of Park Concessionaires.

PROCEDURE FOR LIFTING FIRE USE RESTRICTIONS

When fire danger and fire occurrence moderates the Fire Management Officer shall recommend reduction of fire use restrictions and emergency closures for fire prevention purposes. The Fire Management Officer will consider:

- Weather data
- Fuels data
- Visitor use trends
- On- park fire situation (Number of going fires and their potential, probability of new starts, and on- park suppression resource draw- down)
- Current adjoining National Forest fire use restriction and emergency closure
- enforcement- - SQF, SNF, INF
- Regional and national preparedness plan levels

The Fire Management Officer will consult with the Kings and Sequoia District Rangers.

The Fire Management Officer will recommend to the Chief Ranger and Superintendent the appropriate level of restrictions/closures or lifting of restrictions/closures. A decision memorandum will be approved by the Superintendent.

Once the lifting of restrictions/closures have been approved the Fire Management Officer will coordinate the following in order to lift Stage I, Stage II or Stage III restrictions/closures:

1. Work with the Park Public Information Officer and issue a press release announcing the lifting of the Stage Level(s).
2. Notification of all park visitor center information desk personnel.
3. Notification of all park District and Sub- District rangers.
4. Coordinate the removal and storage of signs.
5. Request that Park Dispatch announce the lifting of restrictions/closures during the morning report broadcast, and put Stage Level information in the written morning report.
6. Notification of Fire Dispatchers at Inyo, Sierra, Sequoia National Forests, and Tulare and Fresno Ranger Units—California Department of Forestry.
7. Notification of Park Concessionaires.

Special Signage During 4th of July

Special "NO FIREWORKS" signs will be posted throughout the Parks seven days prior to, and seven days after the 4th of July holiday. The Fire Management Officer will coordinate the posting of the signs with Sub- District Rangers.

STAGE I

Stage I Trigger Conditions

1. Foothills annual grass has cured to about the 6,000- foot level for all exposures.
2. Fire use restrictions for adjoining National Forests are in effect (SQF, SNF, INF).
3. National Fire Danger Rating Staffing Class for any Park fire weather station is three or higher.

Stage I Scope

1. Will provide some protection for flashy fuels in remote foothill region.
2. Reduces the possibility of a catastrophic fire burning up the Granite Spring Creek drainage above Hospital Rock and endangering the lives of visitors and employees on the Generals Highway.
3. Reduces the possibility of a wildfire escaping the Ash Mountain Picnic Area and threatening Park residences.
4. Does not really impact Cedar Grove, Grant Grove, Giant Forest and Mineral King Sub-Districts since legal fires in the areas are generally in campgrounds or in the backcountry above 6,000 feet.
5. Private property in Silver City is exempt from these regulations.

Stage I signage

Signs should be posted at Ash Mountain picnic areas (optional for Hospital Rock picnic area as needed), "Swinging Bridge" near Potwisha campground, North Fork trailhead, Middle Fork trailhead, and South Fork trailhead- - Kaweah River.

HIGH FIRE DANGER.
NO WOOD OR BARBECUE FIRES BELOW 6,000 FEET,
EXCEPT IN DESIGNATED CAMPGROUNDS.

GAS OR PROPANE STOVES PERMITTED.

STAGE II

Stage II Trigger Conditions (in addition to Stage I)

1. Fire use restrictions for adjoining National Forests are in effect (SQF, SNF, INF).
2. National Fire Danger Rating Staffing Class for any Park fire weather station is four or five.

Stage II Scope

1. Will provide more protection than is covered by Stage I for flashy fuels in remote foothill region.
2. Further reduces the possibility of a catastrophic fire burning up the Granite Spring Creek drainage above Hospital Rock and endangering the lives of visitors and employees on the Generals Highway.
3. Further reduces the possibility of a wildfire escaping the Ash Mountain Picnic Area and threatening Park residences.
4. With respect to campfires, barbecues, and cooking stoves, does not really impact Cedar Grove, Grant Grove, Giant Forest and Mineral King Sub- Districts since legal fires in the areas are generally in campgrounds or in the backcountry above 6,000 feet.
5. Impacts all areas below 6,000 feet with respect to use of campfires, barbecues, and cooking stoves.

6. Impacts all areas below 6,000 feet with respect to smoking, except in vehicles, developed areas, or designated campgrounds.
7. Private property in Silver City is exempt from these regulations.

Stage II Signage

Signs to be posted at trailheads, entrance stations, on bulletin boards in campgrounds and visitor centers, and picnic areas:

VERY HIGH FIRE DANGER.

NO CAMPFIRES, BARBECUES OR COOKING STOVES PERMITTED BELOW 6,000 FEET, EXCEPT IN DESIGNATED CAMPGROUNDS.

NO SMOKING BELOW 6,000 FEET, EXCEPT WITHIN AN ENCLOSED VEHICLE, DEVELOPED AREA, OR DESIGNATED CAMPGROUND.

STAGE III

Stage III Trigger Conditions (in addition to Stage II)

1. Fire use restrictions and closures for adjoining National Forests are in effect (SQF, SNF, INF).
2. National Fire Danger Rating Staffing Class for any Park fire weather station is four or five.
3. Park fire fighting resources are drawn- down fifty percent or more.

Stage III Scope

1. Will provide maximum protection for all areas throughout these Parks and still allow for visitor use.
2. Impacts all areas of these Parks.
3. Private property in Silver City is exempt from these regulations.

Stage III Signage

Signs to be posted at trailheads, entrance stations, on bulletin boards in campgrounds and visitor centers, and picnic areas:

EXTREME FIRE DANGER.

THE FOLLOWING REGULATIONS ARE ENFORCED THROUGHOUT THE PARKS, AT ALL ELEVATIONS:

NO CAMPFIRES OR BARBECUES PERMITTED.
COOKING STOVES ARE PERMITTED WITHIN DESIGNATED CAMPGROUNDS.

NO SMOKING EXCEPT WITHIN AN ENCLOSED VEHICLE OR BUILDING.

SPECIAL SAFETY CONCERNS AND REGULATING ACCESS TO HAZARDOUS AREAS

Hazard Trees

Incident Commanders are responsible for assuring that inspections are conducted for fire damaged, unstable trees that could fail and strike trails, roads, campsites and developed areas.

Official warning signs will be posted on trails, roads, around campsites and developed areas where fire damaged, unstable trees are left standing. The signs are produced by the Fire Management Office. Signs should remain in place until trees posing a hazard to the public and employees are cut down by fallers, or into winter when winter storms are expected to fell unstable trees. The areas may require closure to public and employee entry.

Regulating Access to Hazardous Areas

Coordination between fire overhead and District Rangers and Sub- district Rangers is essential. Fire overhead can recommend to District Rangers action that should be considered. It is the District Ranger's responsibility to determine actual regulatory measures that will be taken to ensure visitor and employee safety on trails, roads, campsites and in developed areas. Fire overhead will coordinate with the District Ranger about who will physically be responsible for making signage postings and physically closing trails or roads.

Most fire operations need only limit access to some front country trails for short periods of time and alternative routes are available to the public. In these cases simply regulating trail use with the use of signs and physically blocking trails is adequate and formal Special Order closures are usually not needed. Special Order closures should be used in situations that involve substantial area, complexity and long duration, such as no other alternative trail routes are available or road access needs to be blocked.

Warning signs should be posted anytime there are fire caused risks to the public or employees from hazards in a burn area involving trails, roads, campsites and developed areas. Signs must have the following basic information included:

Warning Signs

WARNING
NATURE OF THE HAZARD
STEPS TO TAKE TO AVOID THE HAZARD

Closed Area Signs

DANGER
THE AREA THAT IS CLOSED
THE HAZARD CAUSING THE CLOSURE

Area closure and hazard warning signs require posting outside of the hazard area on routes entering the hazard area. The trail or road should be physically blocked with barricades, on roads, or "trail blocks" made of rope and flagging tape on trails. Hazardous situations may

require posting "trail block" personnel if it is likely people may ignore the trail closure- - such as backpackers hiking through on long trips may not want to turn back or use alternative routes.

ATTACHMENT - SPECIAL ORDER FOR AREA CLOSURE

Attached is the Special Order format to be used for making emergency closures for fire prevention and public safety reasons.

_____ _____

Date

Park Superintendent
Sequoia and Kings Canyon National Parks

N - Permit for Burning Slash Piles

Permit Authority: 36 Code of Federal Regulations, sections 1.5, 1.6, 1.7 and 2.13.

Issued To: _____

Address: _____

City/State/Zip: _____

Telephone Number(s): _____

Location of Piles: _____
Attach map(s) that show the location of the slash piles.

Number of Piles: _____ Approximate total cubic footage: _____

Burning shall be confined to the hours between sunrise and sunset. This permit is valid during the period

_____ to _____ .

This permit is subject to the following terms and conditions.

1. The burner agrees to begin burning only after receiving verbal permission on the day prior to, or on the day the burn is to commence from the park Fire Management Office, **559- 565-3164 or 3165**. Verbal permission must be received on a daily basis if new pile ignitions are made beyond one day. Burning may be prohibited during periods of high to extreme fire danger and/or due to air quality regulations.

2. The burner agrees to only burn slash piles that are made of naturally occurring, vegetative fuels that are derived from fire hazard fuel reduction or hazard tree removal projects. No manufactured materials shall be burned including all kinds of construction materials.

3. The burner must not burn during very hot and dry periods when winds are strong enough that burning would be considered unsafe. (Example: wind keeps leaves in motion or extends a light flag or cloth).

4. The fire shall be confined within cleared fuel breaks or barriers adequate to prevent it from escaping control. The burner will maintain the ability to suppress any spot fires.

5. The fire shall be attended at all times by at least one prudent and responsible person who will maintain control of the fire.

6. This permit does not relieve the permit holder of any responsibility concerning reasonable and ordinary care to prevent damage to the property of others or injury to persons as prescribed by law.

7. Additional terms:

_____

I agree to comply with the terms and conditions of this permit.

Signed: _____ Date: _____
Applicant

CAUTION: YOU CAN BE HELD LIABLE FOR ESCAPED FIRES INCLUDING DAMAGE AND SUPPRESSION COSTS.
VIOATIONS OF ANY BURNING PERMIT TERMS OR CONDITIONS ARE A ***VIOLATION OF FEDERAL LAWS AND RENDERS THE PERMIT NULL AND VOID.***

****

Approved by: _____ Date: _____
Park or District Fire Management Officer

Original copy to Fire Dispatch. Copy to permit holder, District Fire Management Officer and District Ranger.

O - Template for Prescribed Fire Burn Plan and Example of Mechanical Treatment Plan

USDI National Park Service
Sequoia and Kings Canyon National Parks

Prescribed Burn Plan

BURN NAME

Prepared by: _____Date: _____

Technical Reviewer: _____Date: _____

Recommended by: _____Date: _____
District Fire Management Officer

Recommended by: _____Date: _____
Park Fire Management Officer

Recommended by: _____Date: _____
Chief Ranger

Recommended by: _____Date: _____
Environmental Specialist

Recommended by: _____Date: _____
Chief, Science and Resources Management

Recommended by: _____Date: _____
Chief, Cultural Resources and Interpretation

Approved by: _____Date: _____
Park Superintendent

For information about this burn unit contact:
Fire Management Office 559- 565- 3164/3165
FAX 559- 565- 3797
24 Hour Park Dispatch 559- 565- 3341

EXECUTIVE SUMMARY

Goals and Objectives

Goal #1 –

Objective -

BURN UNIT DESCRIPTION

A. General Area Description:

B. Location:
County –
Range , Township , section
UTM Zone , Easting , Northing (approximate mid point of the segment)
Longitude, Latitude (approximate mid point of the segment)

C. Fire Management Zone , Area , Unit (1984 and 1992 FMP revision)

D. Size:

E. Elevation Range:

F. Slope Range:

G. Aspect Range:

H. Description of Holding Boundaries:

I. Vegetation Type and Fuel Loading Description:

Vegetation Includes:

Vegetation Type	Fuel Model NFFL	Estimated Acres	Estimated Tons Per Acre

Total Estimated Project Tons:

J. Project Maps - Vicinity, Project, Fuels and Vegetation Maps are attached

PROJECT COMPLEXITY

A. Hot End:

B. Cool End:

BURN ORGANIZATION

A. Hot End

- Prescribed Burn Boss:
- Safety Officer:
- Fire Information Officer:
- Lead Prescribed Fire Monitor:
- Prescribed Fire Ignition Specialist:
- Firing Team:
- Holding Supervision:
- Ignition/Holding Crews/Equipment:
- Slopover Containment Worksheet Resource Needs:

B. Cool End

- Prescribed Burn Boss:
- Safety Officer:
- Fire Information Officer:
- Lead Prescribed Fire Monitor:
- Prescribed Fire Ignition Specialist:
- Firing Team:
- Holding Supervision:
- Ignition/Holding Crews/Equipment:
- Slopover Containment Worksheet Resource Needs:

ESTIMATED COSTS

Item	Planning	Preparation	Execution	Evaluation
Personnel				
Equipment (mileage, rental)				
Aircraft				
Supplies (non-rolling stock)				
Phase Costs				

Total Estimated Cost: (does not include base 8 salary paid out of non- project accounts).

Estimated Cost Per Acre:

SCHEDULING

A. Hot End

- Proposed Ignition Period:
- Expected Burn Duration:
- Note any dates when the burn may not be run during the proposed window:

B. Cool End

- Proposed Ignition Period:
- Expected Burn Duration:
- **Note any dates when the burn may not be run during the proposed window:**

PRE-BURN PLANNING AND PREPARATION CONSIDERATIONS

A. On Site:

B. Off site:

BURNING PRESCRIPTION
FUEL MODEL NFFL 1 - ANNUAL GRASS *

Head Fire

Environmental Conditions
Air Temperature: 30- 90 F
Relative Humidity: 20- 60%
Wind Speed (midflame - MFWS) see combinations with fine fuel moisture below
Slope: 0- 30%
1- Hour Time Lag: 5- 10% (MFWS 0- 2)
10- Hour Time Lag: N/A
100- Hour Time Lag: N/A
1000- Hour Time Lag: N/A
Live: N/A

Fire Behavior Outputs
Scorch Height: N/A
Rate of Spread: 2- 35 chains per hour
Flame Length: 0- 4 ft.
Heat per Unit Area: 55- 95 BTU per square foot

Fireline Intensity: 3- 60 BTU per foot per second

Prescribed Head Fire Matrix for Flame Length (feet) / Rate Of Spread (Chains/hour)			
1 Hour Fuel Moisture	5%	7%	9%
MFWS = 0	2.3 / 20.8	2.2 / 18.6	1.8 / 14.7
MFWS = 1	2.5 / 24.2	2.3 / 21.6	1.9 / 17.1
MFWS = 2	2.9 / 35.0	2.7 / 31.2	2.3 / 24.7

Backing Fire (wind upslope)

Environmental Conditions
Air Temperature: 30- 90 F
Relative Humidity: 20- 60
Wind Speed: (midflame - MFWS) see combinations with fine fuel moisture below
Slope: 0- 100%
1- Hour Time Lag: 3- 4% (MFWS 0- 4) / 5- 10% (MFWS 0- 2)
10- Hour Time Lag: N/A
100- Hour Time Lag: N/A
1000- Hour Time Lag: N/A
Live: N/A

Fire Behavior Outputs
Scorch Height: N/A
Rate of Spread: 2- 8 chains per hour
Flame Length: .5- 2'
Heat per Unit Area: 100- 110 BTU per square foot
Fireline Intensity: 4- 15 BTU per foot per second

These are generalized prescription parameters. The burn boss is responsible for addressing topographic features outside the range listed in order to meet their burn objectives (usually accomplished by varying the firing pattern, sequence and rate of ignition).

BURNING PRESCRIPTION
FUEL MODEL NFFL 2 - GRASS WITH OVERSTORY *

Head Fire

Environmental Conditions
Air Temperature: 30- 90 F
Relative Humidity: 20- 60%
Wind Speed (midflame - MFWS) see combinations with fine fuel moisture below
Slope: 0- 30%
1- Hour Time Lag: 6- 11% (MFWS 0- 2) / 12- 13% (MFWS 0- 6)
10- Hour Time Lag: 7- 12% (MFWS 0- 2) / 13- 14% (MFWS 0- 6) / 15- 16% (MFWS 0- 10)
100- Hour Time Lag: 8- 13% (MFWS 0- 2) / 14- 15% (MFWS 0- 6) / 16- 17% (MFWS 0- 10)
1000- Hour Time Lag: N/A
Live Foliage Moisture: 50- 100%

Fire Behavior Outputs
Scorch Height: 0- 30'
Rate of Spread: 1- 16 chains per hour
Flame Length: .5- 4 ft.
Heat per Unit Area: 255- 495 BTU per square foot
Fireline Intensity: 4- 145 BTU per foot per second

Prescribed Head Fire Matrix for Flame Length (feet) / Rate Of Spread (Chains/hour)			
1 Hour Fuel Moisture	6%	9%	12%
MFWS = 0	3.3 / 8.7	3.1 / 7.6	2.4 / 5.5
MFWS = 2	4.4 / 16.1	4.1 / 14.1	3.1 / 10.2
MFWS = 6	*8.4 / 64.0	*7.7 / 55.8	*5.9 / 40.4

* Out of prescription

Backing Fire (wind upslope)

Environmental Conditions
Air Temperature: 30- 90 F
Relative Humidity: 20- 60%
Wind Speed: (midflame - MFWS) see combinations with fine fuel moisture below
Slope: 0- 100%
1- Hour Time Lag: 4- 9% (MFWS 0- 4) / 10- 13% (MFWS 0- 2)
10- Hour Time Lag: 5- 10% (MFWS 0- 4) / 11- 14 (MFWS 0- 2)
100- Hour Time Lag: 6- 11% (MFWS 0- 4) / 12- 15% (MFWS 0- 2)
1000- Hour Time Lag: N/A
Live Foliage Moisture: 50- 100%

Fire Behavior Outputs
Scorch Height: 0- 30'
Rate of Spread: 1- 3 chains per hour
Flame Length: .5- 2.5'
Heat per Unit Area: 255- 525 BTU per square foot
Fireline Intensity: 4- 30 BTU per foot per second

* These are generalized prescription parameters. The burn boss is responsible for addressing topographic features outside the range listed in order to meet their burn objectives (usually accomplished by varying the firing pattern, sequence and rate of ignition).

BURNING PRESCRIPTION
FUEL MODEL NFFL 4 - TALL BRUSH (CHAMISE & MANZANITA) *

Head Fire

Environmental Conditions
Air Temperature: 30- 85 F
Relative Humidity: 20- 60%

Wind Speed (midflame - MFWS) see combinations with fine fuel moisture below
Slope: 0- 45%
1- Hour Time Lag: 5- 9% (MFWS 0- 4) / 10- 12% (MFWS 0- 8)
10- Hour Time Lag: 6- 10% (MFWS 0- 4) / 11- 13% (MFWS 0- 8)
100- Hour Time Lag: 7- 11% (MFWS 0- 4) / 12- 14% (MFWS 0- 8)
1000- Hour Time Lag: N/A
Live Foliage Moisture: 50- 150%

Fire Behavior Outputs
Scorch Height: N/A
Rate of Spread: 2- 120 chains per hour
Flame Length: 3- 25'
Heat per Unit Area: 1570- 2910 BTU per square foot
Fireline Intensity: 50- 6330 BTU per foot per second

Prescribed Head Fire Matrix for Flame Length (feet) / Rate Of Spread (Chains / hour)			
1 Hour Fuel Moisture	5%	9%	12%
MFWS = 0	12.3 / 24.3	10.9 / 20.8	10.0 / 18.7
MFWS = 4	24.8 / 111.4	22.0 / 95.4	20.2 / 85.6
MFWS = 8	* 36.5 / 257.3	* 32.3 / 220.4	* 29.7 / 197.7

* Out of prescription

* These are generalized prescription parameters. The burn boss is responsible for addressing topographic features outside the range listed in order to meet their burn objectives (usually accomplished by varying the firing pattern, sequence and rate of ignition).

BURNING PRESCRIPTION
FUEL MODEL NFFL 5 - LOW BRUSH **

Head Fire

Environmental Conditions
Air Temperature: 30- 80 F
Relative Humidity: 20- 60%
Wind Speed (midflame - MFWS) see combinations with fine fuel moisture below
Slope: 0- 35%
1- Hour Time Lag: 5- 7% (MFWS 0- 2) / 8- 12% (MFWS 2- 8) with live fuel moisture of 100- 150%
10- Hour Time Lag: 6- 12% (MFWS 0- 2) / 9- 13% (MFWS 0- 8) with live fuel moisture of 100- 150%
100- Hour Time Lag: N/A
1000- Hour Time Lag: N/A
Live Foliage Moisture: 70- 150%

Fire Behavior Outputs
Scorch Height: N/A
Rate of Spread: 2- 17 chains per hour

Flame Length: 1- 5'
Heat per Unit Area: 215- 715 BTU per square foot
Fireline Intensity: 7- 221 BTU per foot per second

Prescribed Head Fire Matrix for Flame Length (feet) / Rate Of Spread (Chains/hour)			
1 Hour Fuel Moisture	5%	7%	12%
MFWS = 0	3.8 / 7.8	3.6 / 7.3	1.2 / 2.3
MFWS = 2	5.4 / 16.9	5.1 / 15.9	1.8 / 5.0
MFWS = 8	* 10.4 / 70.8	* 9.9 / 66.7	* 3.4 / 20.8

* Out of prescription

** These are generalized prescription parameters. The burn boss is responsible for addressing topographic features outside the range listed in order to meet their burn objectives (usually accomplished by varying the firing pattern, sequence and rate of ignition).

BURNING PRESCRIPTION
FUEL MODEL NFFL 8 - CLOSED TIMBER, SHORT NEEDLE CONIFER *

Head Fire

Environmental Conditions
Air Temperature: 40- 85 F
Relative Humidity: 20- 60%
Wind Speed (midflame - MFWS) see combinations with fine fuel moisture below
Slope: 0- 60%
1- Hour Time Lag: 3- 10% (MFWS 0- 10)
10- Hour Time Lag: 4- 11% (MFWS 0- 10)
100- Hour Time Lag: 5- 12% (MFWS 0- 10)
1000- Hour Time Lag: 10- 20%
Live Foliage Moisture: N/A

Fire Behavior Outputs
Scorch Height: 0- 30'
Rate of Spread: 0- 8 chains per hour
Flame Length: 0- 2.5'
Heat per Unit Area: 165- 225 BTU per square foot
Fireline Intensity: 1- 35 BTU per foot per second

Prescribed Head Fire Matrix for Flame Length (feet) / Rate Of Spread (Chains/hour)			
1 Hour Fuel Moisture	3%	7%	10%
MFWS = 0	1.2 / 2.0	0.9 / 1.3	0.8 / 1.1
MFWS = 5	1.7 / 4.3	1.3 / 3.0	1.1 / 2.5
MFWS = 10	2.3 / 8.4	1.5 / 4.2	1.3 / 3.1

* These are generalized prescription parameters. The burn boss is responsible for addressing topographic features outside the range listed in order to meet their burn objectives (usually accomplished by varying the firing pattern, sequence and rate of ignition).

BURNING PRESCRIPTION
FUEL MODEL NFFL 9 - BROADLEAF DECIDUOUS HARDWOODS AND LONG NEEDLE PINE **

Head Fire

Environmental Conditions
Air Temperature: 40- 85 F
Relative Humidity: 20- 60%
Wind Speed (midflame - MFWS) see combinations with fine fuel moisture below
Slope: 0- 45%
1- Hour Time Lag: 5- 7% (MFWS 0- 6) / 8- 12% (MFWS 0- 8)
10- Hour Time Lag: 6- 8% (MFWS 0- 6) / 9- 13% (MFWS 0- 8)
100- Hour Time Lag: 7- 9% (MFWS 0- 6) / 10- 14% (MFWS 0- 8)
1000- Hour Time Lag: 10- 20%
Live Foliage Moisture: N\A

Fire Behavior Outputs
Scorch Height: 0- 30'
Rate of Spread: 1- 18 chains per hour
Flame Length: 1- 4 ft.
Heat per Unit Area: 320- 390 BTU per square foot
Fireline Intensity: 4- 120 BTU per foot per second

Prescribed Head Fire Matrix for Flame Length (feet) / Rate Of Spread (Chains/hour)			
1 Hour Fuel Moisture	5%	7%	12%
MFWS = 2	2.5 / 5.7	2.2 / 4.8	1.9 / 3.7
MFWS = 5	3.6 / 12.5	3.2 / 10.6	2.7 / 8.3
MFWS = 8	* 4.7 / 23.3	* 4.2 / 19.7	3.6 / 15.4

* Out of prescription

Backing Fire (wind upslope)

Environmental Conditions
Air Temperature: 40- 85 F
Relative Humidity: 20- 60
Wind Speed: (midflame - MFWS) see combinations with fine fuel moisture below
Slope: 0- 100%
1- Hour Time Lag: 3- 10% (MFWS 0- 4)
10- Hour Time Lag: 4- 11% (MFWS 0- 4)

100- Hour Time Lag: 5- 12% (MFWS 0- 4)
1000- Hour Time Lag: 10- 20%
Live Foliage Moisture: N\A

Fire Behavior Outputs
Scorch Height: 0- 30'
Rate of Spread: 0- 1 chains per hour
Flame Length: .5- 3'
Heat per Unit Area: 350- 450 BTU per square foot
Fireline Intensity: 4- 60 BTU per foot per second

** These are generalized prescription parameters. The burn boss is responsible for addressing topographic features outside the range listed in order to meet their burn objectives (usually accomplished by varying the firing pattern, sequence and rate of ignition).

BURNING PRESCRIPTION
FUEL MODEL NFFL 10 - TIMBER LITTER *

Head Fire

Environmental Conditions
Air Temperature: 40- 75 F
Relative Humidity: 20- 60%
Wind Speed (midflame - MFWS) see combinations with fine fuel moisture below
Slope: 0- 45%
1- Hour Time Lag: 5- 7% (MFWS 0- 6), 8- 12% (MFWS 0- 8)
10- Hour Time Lag: 6- 8% (MFWS 0- 6), 9- 13% (MFWS 0- 8)
100- Hour Time Lag: 7- 9% (MFWS 0- 6), 10- 14% (MFWS 0- 8)
1000- Hour Time Lag: 10- 20%
Live Foliage Moisture: N\A

Fire Behavior Outputs
Scorch Height: 0- 30'**
Rate of Spread: 1- 18 chains per hour
Flame Length: 1- 4 ft.
Heat per Unit Area: 320- 390 BTU per square foot
Fireline Intensity: 4- 120 BTU per foot per second

Prescribed Head Fire Matrix for Flame Length (feet) / Rate Of Spread (Chains/hour)			
1 Hour Fuel Moisture	5%	7%	12%
MFWS = 2	5.5 / 9.0	5.2 / 8.2	4.6 / 6.9
MFWS = 6	8.3 / 21.4	7.7 / 19.5	6.9 / 16.6
MFWS = 8	9.6 / 29.4	8.9 / 26.8	7.9 / 22.7

Backing Fire (wind upslope)

Environmental Conditions
Air Temperature: 40- 85 F
Relative Humidity: 20- 60
Wind Speed: (midflame - MFWS) see combinations with fine fuel moisture below
Slope: 0- 100%
1- Hour Time Lag: 3- 10% (MFWS 0- 4)
10- Hour Time Lag: 4- 11% (MFWS 0- 4)
100- Hour Time Lag: 5- 12% (MFWS 0- 4)
1000- Hour Time Lag: 10- 20%
Live Foliage Moisture: N\A

Fire Behavior Outputs
Scorch Height: 0- 30'
Rate of Spread: 0- 1 chains per hour
Flame Length: .5- 3'
Heat per Unit Area: 350- 450
Fireline Intensity: 4- 60

* These are generalized prescription parameters. The burn boss is responsible for addressing topographic features outside the range listed in order to meet their burn objectives (usually accomplished by varying the firing pattern, sequence and rate of ignition).

FIRING AND HOLDING PLAN

A. Test Fire Procedure:

B. Firing Procedure

- Hot End:
- Cool End:
- Describe actions to be taken if burning prescriptions are exceeded on the hot end.:

C. Holding Procedure

- Hot End:
- Cool End:
- Describe actions to be taken if burning prescriptions are exceeded on the cool end.:

D. Slop- over Containment Procedure

- Potential Slope- over Area(s):
- Critical Holding Area(s):
- Slopover Containment Resource Needs:
- Initial Slopover Notification Procedure:

SMOKE MANAGEMENT AND AIR QUALITY

Smoke Emissions

A. Estimated Smoke Emissions Period:

B. Estimated Smoke Emissions:

Estimated PM- 10 Emissions

Fuel Type	Total Burn Unit Estimated Emissions
NFFL 1 – annual grass	19 pounds/acre x acres burned = pounds
NFFL 2 – grass with overstory	42 pounds/acre x acres burned = pounds
NFFL 4 – tall brush (chamise and manzanita)	322 pounds/acre x acres burned = pounds
NFFL 5 – low brush	70 pounds/acre x acres burned = pounds
NFFL 8 – closed timber, short needle conifer	258 pounds/acre x acres burned = pounds
NFFL 9 – broadleaf deciduous hardwoods and long needle pine	1,293 pounds/acre x acres burned = pounds
NFFL 10 – timber litter	1,650 pounds/acre x acres burned = pounds
SEKI Custom 14 low elevation short needle conifer	1,321pounds/acre x acres burned = pounds
SEKI Custom 18 high elevation short needle conifer	1,251pounds/acre x acres burned = pounds

Total Estimated PM- 10 Emissions: pounds.

Estimated CO Emissions

Fuel Type	Total Burn Unit Estimated Emissions
NFFL 1 – annual grass	184 pounds/acre x acres burned = pounds

NFFL 2 – grass with overstory	302 pounds/acre x acres burned = pounds
NFFL 4 – tall brush (chamise and manzanita)	3,196 pounds/acre x acres burned = pounds
NFFL 5 – low brush	698 pounds/acre x acres burned = pounds
NFFL 8 – closed timber, short needle	2,332 pounds/acre x acres burned = pounds
NFFL 9 – broadleaf deciduous hardwoods and long needle pine	11,816 pounds/acre x acres burned = pounds
NFFL 10 – timber litter	15,800 pounds/acre x acres burned = pounds
SEKI Custom 14 low elevation short needle conifer	12,625 pounds/acre x acres burned = pounds
SEKI Custom 18 high elevation short needle conifer	11,950 pounds/acre x acres burned = pounds

Total Estimated CO Emissions: pounds

* Estimated emissions based on FOFEM calculations using park average fuel loadings and average prescription conditions- - fuel moisture and consumption (2001).

Smoke Sensitive Areas

(attach map showing smoke sensitive areas with in 15 miles of the burn unit and show day time and night time estimated smoke plume directions)

A. Smoke Sensitive Areas Within 15 Miles of Burn Unit:

Smoke Sensitive Area	Distance From Burn Unit	Compass Direction From Burn Unit (SW, N, etc.)	Population	Critical Receptors - schools - retirement communities - general hospitals

B. Estimated Smoke Impact to Smoke Sensitive Areas:

- Desirable Smoke Dispersal Transport Winds Direction and Speed:
- Undesirable Smoke Dispersal Transport Winds Direction and Speed:
- Estimated Day Time Smoke Plume Direction and Potential Impact:
- Estimated Night Time Smoke Plume Direction and Potential Impact:

Smoke Monitoring

A. Type and Interval of Monitoring:

B. Smoke Sensitive Area Health Impacts Monitoring:

Burn Day Regulation

A. Burn Day Notice Procedure:

Roadway Safety

Minimum acceptable visibility and speed limits, or traffic control, for all public roadways will be enforced by speed limit signs or traffic controllers. Any compromised roadway conditions should be relayed to the Burn Boss immediately, day or night, on shift or off shift.

Road Control Guideline For Two Lane, Two Way Road, Day Light Hours:

Posted Speed Limit	Minimum Acceptable Visibility
10 mph	56 feet if less than 56 feet begin one-way traffic control
15 mph	100 feet
25 mph	216 feet
35 mph	370 feet
45 mph	566 feet

Road Control Guideline For Two Lane, Two Way Road, Night Time Hours:

Posted Speed Limit	Minimum Acceptable Visibility
10 mph	112 feet if less than 112 feet begin one-way traffic control
15 mph	200 feet
25 mph	432 feet
35 mph	740 feet
45 mph	1132 feet

ESCAPED FIRE AND SMOKE CONTINGENCY TRANSITION PLANNING

A. Transition to Wildland Fire Planning Process:

B. Smoke Contingency - Mitigation of Smoke Impacts to Smoke Sensitive Areas based on information described in the Smoke Management and Air Quality section

- Notification and Coordination with Impacted Air District Procedure:
- Logging of Smoke Complaints Procedure:
- Community Outreach Procedure:
- Media Contact Procedure:
- Smoke Impact Reduction Procedure:
- Transition to Wildand Fire Planning Process:

PROTECTION OF SENSITIVE FEATURES

A. Identification and Protection of Sensitive Species Procedure:

B. Cultural Clearance Procedure:

PUBLIC AND FIRE PERSONNEL SAFETY

A. Public Safety Procedure

- Fire Hazards:

B. Fire Personnel Safety Procedure

- Fire Hazards:
- Unhealthy Smoke:

C. First Aid and MEDIVAC Procedure:

INTERAGENCY/INTRAGENCY COORDINATION AND PUBLIC INVOLVEMENT

A. Employee and Public Information Outreach Procedure:

B. Fire Dispatch Situation Update Procedure:

MONITORING AND EVALUATION

A. Fuels:

B. Weather:

C. Fire Behavior:

D. Smoke Behavior:

E. Fire Effects:

REHABILITATION

A. Rehabilitation Procedure:

DOCUMENTATION

ATTACHEMENTS

- Wildland and Prescribed Fire Complexity Rating Worksheet
- Wildland and Prescribed Fire Complexity Rating Worksheet Numeric Rating Guide
- Park Superintendent Go/No- Go Pre- Ignition Approval
- Briefing Guide
- Burn Plan Execution Go/No Go Checklist
- Slopover Containment Resource Needs Worksheet
- Burn Plan Technical Review
- Park Review Comments
- Cultural Resources Clearance.
- Vicinity Map.
- 7.5 minute project topographic map (original) showing geographic organizational lay- out using ICS map symbols and terminology, and shows critical holding areas and values at risk inside and outside the burn segment area.
- 7.5 minute project vegetation map.
- 7.5 minute project fuels map.

WILDLAND AND PRESCRIBED FIRE COMPLEXITY RATING WORKSHEET

Complexity element	Weighting factor	Complexity value	Total points
Safety	5		
Threats to boundaries	5		
Fuels and fire behavior	5		
Objectives	4		
Management organization	4		
Improvements	3		
Natural, cultural, social values	3		
Air quality values	3		
Logistics	3		
Political concerns	2		
Tactical operations	2		
Interagency coordination	1		
Total complexity points			
Complexity Rating (circle)	L	M	H

Complexity Value Breakpoints:

Low 40–90 – ***Burn Boss 2 Required***
Moderate 91–140 – ***Burn Boss 2 Required***
High 141– 200 – ***Burn Boss 1 and Safety Officer Required***

The Wildland and Prescribed Fire Complexity Analysis provides a method to assess the complexity of both wildland and prescribed fires. The analysis incorporates an assigned numeric rating complexity value for specific complexity elements that are weighted in their contribution to overall complexity. The weighted value is multiplied times the numeric rating value to provide a value for that item. Then all values are added to generate the total complexity value. Breakpoint values are provided for low, moderate, and high complexity values. **Only use Complexity Values 1, 3 or 5 – no even numbers allowed.**

The complexity analysis worksheet is accompanied by a guide to numeric values for each complexity element shown, provided on the following pages.

WILDLAND AND PRESCRIBED FIRE COMPLEXITY RATING WORKSHEET NUMERIC RATING GUIDE

COMPLEXITY ELEMENT	GUIDE TO NUMERIC RATING		
	1	3	5
Safety	Safety issues are easily identifiable and mitigated	Number of significant issues have been identified All safety hazards have been identified on the LCES worksheet and mitigated	SOF1 or SOF2 required Complex safety issues exist
Threats to Boundaries	Low threat to boundaries POI<50% Boundaries naturally defensible	Moderate threat to boundaries 50<POI<70% Moderate risk of slopover or spot fires Boundaries need mitigation actions for support to strengthen fuel breaks, lines, etc.	High threat to boundaries POI>70% High risk of slopover or spot fires Mitigation actions necessary to compensate for continuous fuels
Fuels/Fire Behavior	Low variability in slope & aspect Weather uniform and predictable Surface fuels (grass, needles) only Grass/shrub, or early seral forest communities Short duration fire No drought indicated	Moderate variability in slope & aspect Weather variable but predictable Ladder fuels and torching Fuel types/loads variable Dense, tall shrub or mid-seral forest communities Moderate duration fire Drought index indicates normal conditions to moderate drought; expected to worsen	High variability in slope & aspect Weather variable and difficult to predict Extreme fire behavior Fuel types/loads highly variable Late seral forest communities or long-return interval fire regimes Altered fire regime, hazardous fuel /stand density conditions Potentially long duration fire Drought index indicates severe drought; expected to continue

COMPLEXITY ELEMENT	GUIDE TO NUMERIC RATING		
	1	3	5
Objectives	Maintenance objectives Prescriptions broad Easily achieved objectives	Restoration objectives Reduction of both live and dead fuels Moderate to substantial changes in two or more strata of vegetation Objectives judged to be moderately hard to achieve Objectives may require moderately intense fire behavior	Restoration objectives in altered fuel situations Precise treatment of fuels and multiple ecological objectives Major change in the structure of 2 or more vegetative strata Conflicts between objectives and constraints Requires a high intensity fire or a combination of fire intensities that is difficult to achieve
Management Organization	Span of control held to 3 Single resource incident or project	Span of control held to 4 Multiple resource incident or project Short-term commitment of specialized resources	Span of control greater than 4 Multiple branch, divisions or groups Specialized resources needed to accomplish objectives Organized management team (FUMT, IMT)
Improvements to be Protected	No risk to people or property within or adjacent to fire	Several values to be protected Mitigation through planning and/or preparations is adequate May require some commitment of specialized resources	Numerous values and/or high values to be protected Severe damage likely without significant commitment of specialized resources with appropriate skill levels
Natural, Cultural, and Social Values to be Protected	No risk to natural, cultural, and/or social resources within or adjacent to fire	Several values to be protected Mitigation through planning and/or preparations is adequate May require some commitment of specialized resources	Numerous values and/or high values to be protected Severe damage likely without significant commitment of specialized resources with appropriate skill levels

COMPLEXITY ELEMENT	GUIDE TO NUMERIC RATING		
	1	3	5
Air Quality Values to be Protected	Few smoke sensitive areas near fire Smoke produced for less than 1 burning period Air quality agencies generally require only initial notification and/or permitting No potential for scheduling conflicts with cooperators	Multiple smoke sensitive areas, but smoke impact mitigated in plan Smoke produced for 2-4 burning periods Daily burning bans are sometimes enacted during the burn season Infrequent consultation with air quality agencies is needed Low potential for scheduling conflicts with cooperators	Multiple smoke sensitive areas with complex mitigation actions required Health or visibility complaints likely Smoke produced for greater than 4 burning periods Multi-day burning bans are often enacted during the burn season Smoke sensitive class 1 airsheds Violation of state and federal health standards possible Frequent consultation with air quality agencies is needed High potential for scheduling conflicts with cooperators
Logistics	Easy access Duration of fire support is less than 4 days	Difficult access Duration of fire support between 4 and 10 days Logistical position assigned Anticipated difficulty in obtaining resources	No vehicle access Duration of support is greater than 10 days Multiple logistical positions assigned Remote camps and support necessary
Political Concerns	No impact on neighbors or visitors No controversy No media interest	Some impact on neighbors or visitors Some controversy, but mitigated Press release issued, but no media activity during operations	High impact on neighbors or visitors High internal or external interest and concern Media present during operations

COMPLEXITY ELEMENT	GUIDE TO NUMERIC RATING		
	1	3	5
Tactical Operations	No ignition or simple ignition patterns Single ignition method used Holding requirements minimal	Multiple firing methods and/or sequences Use of specialized ignition methods (i.e. terra-torch, Premo Mark III) Resources required for up to one week Holding actions to check, direct, or delay fire spread	Complex firing patterns highly dependent upon local conditions Simultaneous use of multiple firing methods and/or sequences Simultaneous ground and aerial ignition Use of heli-torch Resources required for over 1 week Multiple mitigation actions at variable temporal and spatial points identified. Success of actions critical to accomplishment of objectives Aerial support for mitigation actions desirable/necessary
Interagency Coordination	Cooperators not involved in operations No concerns	Simple joint-jurisdiction fires Some competition for resources Some concerns	Complex multi-jurisdictional fires High competition for resources High concerns

PARK SUPERINTENDENT GO/NO GO PRE-IGNITION APPROVAL

_____
Burn Plan Name

Instructions. The Superintendent's Go/No Go Pre- ignition Approval is the final management approval prior to execution of the prescribed burn and evaluates whether compliance requirements, prescribed fire plan elements, and internal and external notifications have been completed. This approval is for the initial execution of the prescribed burn. If ignition of the prescribed fire is not initiated prior to the expiration date determined by the Superintendent, a new one will be completed.

The answer to each of the following must be yes.

____ Is the prescribed burn plan up to date?

____ Is Risk Management in place?

____ Have all compliance requirements been completed?

____ Are all elements of the prescribed fire plan being met?

____ Have all internal and external notifications been made?

Recommended by: _____ _____
Park Fire Management Officer Date

Approved by: _____ _____
Park Superintendent Date

Approval Expires: _____
Date

BRIEFING GUIDE

A. Operational Objectives

B. Organizational Assignments

C. Incident Safety
- fire personnel safety procedure
    - fire hazards
    - unhealthy smoke
    - environmental hazards
    - LCES
- public safety procedure
    - fire hazards
    - unhealthy smoke
- first aid and MEDIVAC procedure

D. Incident Operations Strategy and Tactics
- prescription parameters
- test fire procedure
- firing procedure
- expected fire behavior
- holding procedure
- slop over containment procedure
- sensitive features
- weather forecast

E. Incident Communications
- radio frequencies
- radio use protocol
- available telephones and FAX
- fire dispatch situation update procedure

D. Incident Logistics
- equipment support procedure
- supplies support procedure
- food and water procedure
- sanitation facilities
- sleeping areas

E. Incident Finance/Administration
- personnel time keeping procedure
- compensation for injuries procedure
- damage to, or loss of equipment and supplies reporting procedure
- disposable supplies replacement procedure

F. Other:

G. Feedback

BURN PLAN EXECUTION GO/NO GO CHECKLIST

The answer to each of the following must be yes.

____ Burn plan is approved by park superintendent and distributed to key field supervisors.

____ Burn plan is approved by the local air district.

____ Park Superintendent Go/No Go Pre- ignition Approval is complete and current.

____ All personnel required in the IAP plan are on site.

____ All equipment and supplies required in the IAP are in position and working properly.

____ Employee and public information outreach is complete.

____ Fire monitoring is ready:
- fire weather observations
- fire behavior observations
- smoke observations
- fire effects plots/transects observations

____ IAP is distributed to overhead personnel.

____ All fire personnel have received a briefing.

____ All prescription parameters have been met:
- pre- burn preparation is complete
- smoke management is favorable
- burning prescription if favorable
- current and forecasted weather is favorable
- sensitive species review is complete
- cultural clearance is complete

____ Fire dispatch has made required notifications.

____ Contingency resources described in the plan have been committed and are available within the specified time- frames.

____ A significant test fire designed to establish fire control and smoke dispersal is ready to go.

____ Incident personnel are ready to enforce roadway speed limits or control traffic due to reduced visibility per Smoke Management and Air Quality.

____ There are no extenuating circumstances that preclude successful completion of this project.

All above elements must be yes in order to proceed with the test fire.

____ Test fire demonstrates that holding resources are able to safely implement holding tactics.

____ Fire behavior is within prescription and is expected to stay in prescription into the foreseeable future.

____ Test fire results indicate burn objectives will be met.

_____
Burn Plan Name

_____	_____	_____	_____
Ignition Specialist Printed Name	Signature	Date	Time
_____	_____	_____	_____
Holding Supervisor Printed Name	Signature	Date	Time
_____	_____	_____	_____
Burn Boss Printed Name	Signature	Date	Time

SLOPOVER CONTAINMENT RESOURCE NEEDS WORKSHEET

Slopover containment resource needs are determined by analyzing the worst case slopover scenario based on the location along the burn perimeter that poses the most threat of slopover and calculating the potential spread and fire intensity of the slopver by using environmental inputs from the hot end and cool of the burning prescription and making BEHAVE run. The output information provided by the BEHAVE run is then used along with the standard fireline production rates found in the Fireline Handbook to determine the resources that would be needed to contain the slopover at established time intervals.

Burn Plan Name: _____ *See Attached BEHAVE Run*

Fire Behavior Fuel Model	Specific Conditions	Type 1* Hand Crew	Type 2* Hand Crew	Chains per Crew Hour** Nunber of Persons in Crew 1	2	3	4	5
1 Short Grass	Grass Tundra	30 9	18 5	6 2	12 8	24 15	35 24	40 30
2 OpenTimber/Grass Understory	All	24	16	3	7	15	21	25
3 Tall Grass	All	5	3	2	5	10	14	16
4 Chapparal	Chapparal High Pocosin	5 4	3 2	2 2	3 4	8 10	15 15	20 18
5 Bush	All	6	4	3	6	12	16	20
6 Dormant Brush/Hardwood Slash	Black Spruce Others	7 6	5 4	3 3	6 6	10 12	16 16	20 20
7 Southern Rough	All	4	2	2	5	12	16	20
8 Closed Timber Litter	Conifers Hardwoods	7 40	5 24	3 10	8 30	15 40	20 50	24 60
9 Hardwood Litter	Conifers Hardwoods	28 40	16 24	3 8	7 25	12 40	18 50	22 60
10 Timber Litter	All	6	4	3	8	12	16	20
11 Light Logging Slash	All	15	9	3	8	12	16	20
12 Medium Logging	All	7	4	3	5	10	16	20
13 Heavy Logging Slash	All	5	3	2	4	8	15	20

* Sustained line production rates of 20-person crews for Construction, Burnout, and Holding in Chains per Hour. Allowances have been made in production rates for rest periods and cumulative fatigue.
** These rates are to be used for estimating initial action productivity only. DO NOT use these rates to estimate sustained line construction, burnout, and holding productivity. Initial action may consist of scratch line construction and hotspotting.

Time Lapsed	Hot/Cool RX End	Fuel Model	Hand Crew Type	Line Production Rate in Chains per Hour	Chains of Line Needing Completion	Number of Crews Needed
1	Hot					
3	Hot					
6	Hot					

12	Hot					
1	Cold					
3	Cold					
6	Cold					
12	Cold					

Prepared by: _____ Date: _____
Job Title

BURN PLAN TECHNICAL REVIEW

Burn Plan Name: _____

Burn Plan Section	Review Status	Date	Initials
Signature Page			
Executive Summary			
Goals and Objectives			
Burn Unit Description			
Project Complexity			
Burn Organization			
Estimated Costs			
Scheduling			
Pre-Burn Planning and Preparation Considerations			
Burning Prescription			
Firing and Holding Plan			
Smoke Management and Air Quality			
Escaped Fire and Smoke Contingency Transition Planning			
Protection of Sensitive Features			
Public and Personnel Safety			
Interagency/Intragency Coordination and Public Involvement			
Monitoring and Evaluation			
Rehabilitation			
Documentation			
Attachments: Cultural Resources Clearance Prescribed Fire Complexity Rating Guide Slopover Containment Resource Needs Worksheet Technical Review Park Staff Comments Park Superintendent Go/No Go Pre-ignition Approval Briefing Guide Burn Plan Execution Go/No Go Checklist Vicinity Map 7.5 minute project topographic map 7.5 minute project vegetation map 7.5 minute project fuels map			

Status:

+ Adequate – meets NPS standards
o Adequate with modification – see comments
- Deficient
NC Unable to evaluate

Comments:

Reviewed by: _____ Date: _____
Job Ttile

PARK REVIEW COMMENTS

Burn Plan Name: _____

Please note comments you have concerning this prescribed burn plan.

Fire Management Officer:

Division of Visitor and Fire Management:

Division of Science and Resources Management:

Dvision of Cultural Resources and Interpretation:

Superintendent:

Other:

USDI National Park Service
Sequoia and Kings Canyon National Parks

Manual Fuels Treatment Plan

PROJECT NAME: Silver City

Prepared by: Corky Conover Date: 3/20/02

Recommended by: _____Date: _____
District Ranger

Recommended by: _____Date: _____
District FMO

Recommended by: _____Date: _____
Park Fire Management Officer

Recommended by: _____Date: _____
Chief Ranger

Recommended by: _____Date: _____
Natural Resources Management Specialist (Fire)

Recommended by: _____Date: _____
Chief, Resources Management & Fire Management Committee Chair

Recommended by: _____Date: _____
Chief, Cultural Resources and Interpretation

Approved by: _____Date: _____
Park Superintendent

For information about this project contact:
Fire Management Office 559- 565- 3164/3165
FAX 559- 565- 3797
24- Hour Park Dispatch 559- 565- 3341

EXECUTIVE SUMMARY

Due to extensive fire suppression over the past century, dead and down fuels continue to accumulate in the forests of the East Fork of the Kaweah River. Dense thickets of small trees and shrubs that would have been kept in check by frequent natural fires contribute additional significant risk to the human made developments and infrastructure.

The proposed work will restore the project sites to more natural fuel load and forest structure while creating a reduced fuel environment between the developments and extensive NPS wildlands and wilderness surrounding the developments. The reduced fuel areas will facilitate the proactive implementation of the parks fire management objectives of restoring fire to the surrounding ecosystem and providing for public and firefighter safety.

The Silver City development contains private lands, park service lands and structures (private and NPS), and are fully surrounded by NPS lands. Private landowners have worked to reduce hazardous levels of fuels in and adjacent to their buildings and within property lines. The efforts on the private lands are, in some cases, inadequate for providing defensible space in the event of a wildfire due to the extreme fuel load on adjacent NPS lands. The NPS has been working over the past six years to reintroduce fire to the East Fork as a way to restore and maintain ecosystem function as well as to reduce hazardous levels of fuels. To continue to implement the prescribed fire program while buffering the private lands from wildfire, the park proposes to create hazard fuel buffers at strategic points around those developments. The buffers would be used by the NPS as zones to implement prescribed fire projects outward onto adjacent wildlands. The buffers would provide an additional measure of defensible space to residents in case of a wildfire.

DESCRIPTION OF THE FUELS TREATMENT AREA

1. General Area Description: The project area is located in the middle third of the East Fork of the Kaweah river drainage on a southern aspect. The project would provide a 200 foot reduced fuel buffer below the Silver City development (Private and NPS) and the only access road. A handline and prescribed fire project will be implemented in the future to provide fire protection from above the development.
2. Location:
    A. Tulare County
    B. 36° 27' 54" Latitude 118° 38' 48" Longitude
    C. Kaweah Zone - East Fork Fire Management Unit
3. Geographic Attributes:
    A. Project Size: 25 acres
    B. Elevation range: 6040 – 7000 feet.
    C. Slope range: 0 –50%
    D. Aspect: S- SW
4. Project Boundaries (**See Project Map**): The project is bounded to the north by the Mineral King road. To the west the 200 foot wide treatment zone goes from the Mineral King road at about 6860 foot elevation down hill to the S- SE to just above (6720' elevation) the NE corner of the Kaweah Hahn private in holding boundary due south to the East Fork along the eastern edge of the in holding property boundary. To the south,

the 200- foot wide treatment zone goes from just below the SE corner of the Silver City private property boundary at approximately 6800- foot level along the contour to the W/SW to the intersection with the western project boundary at about the 6720- foot elevation. To the east the 200 foot wide treatment zone goes from the Mineral King road on the east side of the NPS housing area to about the 6860 contour level and then goes west to the east side of the Silver City private property boundary back up to the road.

5. Vegetation Types: The project is located in the White Fir Mixed Conifer vegetation type with no recent recorded history of fire disturbance. The fuels can best be represented by Northern Forest Fire Lab (NFFL) fuel model 10.

Vegetation Type	Fuel Model NFFL	Estimated Acres	Estimated Tons Per Acre
Heavy timber litter with understory vegetation	NFFL 10	25	86.85 tons/acre x 25 acres = 2171 tons

Total Estimated Pre- Project Tons/acre: 2117 tons/acre. Tons per acre estimate based on park-wide average fuel loading data for areas that have not been burned in the White Fir Mixed Conifer Vegetation Type since fire exclusion began in the late 19th century.

GOALS AND OBJECTIVES

The main project goal is to provide a reduced fuel buffer around the Silver City development that will allow for the protection of the development, provide for public and fire fighter safety during fire events, and facilitate the restoration of fire to the surrounding wildlands.

1. Fuel Reduction: To reduce the total dead and down woody fuel loading to less than 12 tons/acre and maintain this load within the treatment zone into the future.
2. Forest Structure: To reduce the number of smaller understory trees so that there will be a maximum of 25 tree/acre less than 40 feet in height remaining within the treatment zone and maintain this into the future.

ESTIMATED COSTS

Item	Planning	Execution	Evaluation
Personnel	1000	45,000	5,000
Equipment (mileage, rental)	50	500	250
Aircraft	N/A	N/A	N/A
Supplies (non-rolling stock)	50	250	250
Phase Costs	1,100	45,750	5,500

Total estimated cost: $52,350. (Does not include base 8 salary paid out of non-project accounts)
Estimated cost per acre: $2094.00

STATEMENT OF WORK

Silver City Developed Area Initial Thinning and Maintenance Specifications
Hazard Abatement Reduction Operations

Responsible Position Target Date	Duties
Contract Crew or Fire Management Fire Crew(s). • Initial treatment by the end of November of the year the work starts.	A 200 foot wide shaded fuel buffer around the development below the road will be thinned from below and cleared according to the following fuel hazard reduction and landscape considerations (see attached map). • There will be a maximum of 25 trees/acre less than 40 feet in height remaining after the thinning. • All live trees over 40 feet tall will remain uncut. All larger trees remaining will be limbed up to at least 6 feet above the ground. • When removing a lateral branch at its point of origin on the trunk or parent limb, the final cut shall be made in branch tissue close to the trunk or parent limb, without cutting into the branch bark ridge or collar, or leaving a stub. • When removing a dead branch, the final cut shall be made just outside the collar of live tissue. If the collar has grown out along the branch stub, only the dead stub shall be removed. The live collar shall remain intact and uninjured. • To prevent damage to the parent limb when removing a branch with a narrow branch attachment, the final cut shall be made from the bottom of the branch up. • Tree branches shall be removed in such manner so as not to cause damage to other parts of the tree. Branches too large to support with one hand shall be pre-cut to avoid splitting or tearing of the bark. • Felled trees will be limbed and bucked down to an 8-inch top and piled for later burning. Tree boles larger than 8 inches in diameter will be left unbucked. All tree boles left will remain in contact with the ground. All stumps will be flush cut and added to the burn piles. • Dead & down woody material (1-8 inches in diameter) will be gathered and piled with larger logs limbed and bucked to an 8 inch top and piled for later burning. Tree boles larger than 8 inches in diameter will be left unbucked. • Piles shall be appropriately sized and located in openings far enough away from residual vegetation to prevent or minimize scorch. • Piles shall have a minimum height of 3 feet and a maximum height of 6 feet. • Piles shall be located at least 15 feet from any residual green tree in the downhill or side-slope direction from the pile, and at least 20 feet from any residual green tree upslope of the pile. • Piles shall be constructed reasonably compact and free of soil to facilitate burning. • Piles shall also be constructed with enough fine material (less than ¼ inch diameter), such as twigs and needles, to easily ignite and burn the pile. • All piles should have a good base to prevent the pile from toppling. • Piles shall be covered with durable paper prior to precipitation.

• Local Fire Management Crew(s). • Maintenance of the fuel treatment zone annually by the end of July.	Water resistant "Kraft" paper (Clean Burn Kraft Paper – available from http://www.baileys-online.com/store.html – see attached tear sheet) or approved substitute may be used. No plastic material will be used to cover piles. The covering shall be placed over the center of the pile. The paper shall cover a minimum of 75% of the surface of each pile. • Pieces of branch wood shall be placed on the top to secure the paper against reasonable wind events. • Larger brush patches will have a minimum 20-foot wide path cleared, and the cut material piled for later burning to facilitate future Fireline construction located in a defensible area within the treatment area. • Any stumps larger than 8 inches in diameter will be treated with borax to prevent root rot. The treatment zone will be maintained on a regular and reoccurring basis. • Established seedlings and saplings will be thinned every 10-15 years to maintain stocking densities at prescribed levels favoring shade intolerant species. The slash generated will be piled and burned. • The 20 foot wide, cleared brush zone will be maintained by cutting sprouting brush on a 5-10 year cycle. The cut material will be piled and burned. • Re-accumulations of dead & down woody material will be gathered and piled with larger logs limbed and bucked to an 8-inch top and piled for later burning on a 5-year cycle.

Silver City Pre Thinning Representation

3-MC-3

Data Associated with Pre Treatment Photo Representation

DATA SHEET Residue descriptive code 3-MC-3

LOADING

Size class (inches)	Weight (tons/acre)	Volume (ft³/acre)
0.0 - 0.25	0.8	51
0.26- 1.0	2.7	180
1.1 - 3.0	2.6	209
3.1 - 9.0	10.6	848
9.1 -20.0	26.8	2,257
20.1+	0	0
Total	43.5	3,545

OTHER MEASUREMENTS

Average residue depth	(feet)	1.2
Ground area covered by residue	(percent)	75
Average duff and litter depth	(inches)	1.1
Ground area covered by duff and litter	(percent)	91
Sound residue 3.1-inch diameter and larger	(percent)	88
Rotten residue 3.1-inch diameter and larger	(percent)	12

STAND INFORMATION

Trees over 20-inch d.b.h.
Dominant species grand fir
Trees per acre 17
Average d.b.h. (inches) 22
Average tree height (feet) 58
Average crown height (feet) 11
Estimated crown space occupied (percent) 10

Trees and dead stems under 8-inch d.b.h.
Dominant species Douglas-fir
Trees per acre 150
Average d.b.h. (inches) 2
Average tree height (feet) 9
Average crown height (feet) 1
Estimated crown space occupied (percent) 10

Trees 8- to 20-inch d.b.h.
Dominant species Douglas-fir
Trees per acre 156
Average d.b.h. (inches) 15
Average tree height (feet) 75
Average crown height (feet) 27
Estimated crown space 50

Snags 8-inch d.b.h. and over
Number per acre 21
Average d.b.h. 23
Average height 60

BRUSH INFORMATION

Dominant species wildrose
Average height (inches) 17
Average crown height (inches) 14
Ground space occupied (percent) 2

GRASS AND FORBS INFORMATION

Dominant species elk sedge
Average height (inches) 4
Ground space (percent) 11
Estimated weight (pounds per acre)

ASSESSMENT OF FIRE BEHAVIOR AND SUPPRESSION DIFFICULTY

Spread rate (chains/hour) 3
Flame length (feet) 4
Resistance to suppression (chains/man-hour) 1.1

Ecoclass coding CWF3-11

REMARKS

Silver City Post Treatment Representation

1-MC-4-PC

Data Associated with Post Treatment Photo Representation

DATA SHEET Residue descriptive code 1-MC-4-PC

LOADING

Size class (inches)	Weight (tons/acre)	Volume (ft^3/acre)
0.0 - 0.25	0.2	13
0.26- 1.0	2.0	134
1.1 - 3.0	3.8	304
3.1 - 9.0	.5	42
9.1 -20.0	0	0
20.1+	0	0
Total	6.5	493

OTHER MEASUREMENTS

Average residue depth		(feet)	0.01
Ground area covered by residue 1/4-inch diameter and larger		(percent)	89
Average duff and litter depth		(inches)	.1
Sound residue 3.1-inch diameter and larger	white fir	(percent)	60
	incense-cedar	(percent)	40
		(percent)	
Rotted residue 3.1-inch diameter and larger		(percent)	0

HARVEST INFORMATION

			HARVEST INFORMATION SOURCE	
			Sale records	Onsite estimation
Gross volume	(M fbm/acre)	4.6	x	
Net volume	(M fbm/acre)	4.6	x	
Average stems/acre cut		15	x	
Average d.b.h. of stems cut	(inches)	22	x	
Stand age	(years)	150		x
Cutting prescription	Tree selection		x	
Yarding method	Tractor		x	
Slash treatment	Machine pile & burn			x
Period since cut or treatment	(months)	8		x

ASSESSMENT OF FIRE BEHAVIOR AND SUPPRESSION DIFFICULTY

Spread rate	(chains/hour)	3
Flame length	(feet)	2
Resistance to suppression	(chains/man-hour)	6.0

REMARKS

PROTECTION OF SENSITIVE FEATURES

The project area will be cleared by the cultural resources specialist prior to the start of any work. A Finding of No Significant Impact (FONSI) was signed by the park's superintendent and approved by the regional director on 12/31/01. The following table is taken from the FONSI mentioned above following the project Environmental Assessment (EA).

Resource Value	Mitigation	Responsible Party
Public and Firefighter Safety	Implementation of the reduced fuel buffers will be carefully planned and conducted with full consideration of public safety. Project areas will be closed for short duration (1 hour to 1 week) to provide for safety during felling and clearing operations and during pile burning. Closures will be coordinated with Silver City Resort and other residents to minimize conflicts. Trees and snags to be removed will be felled away from private property and structures. Firefighter safety will be high priority and will be stressed through adherence to the standard firefighting orders and the use of full personal protective equipment at all times. A job hazard analysis will be conducted prior to any work, and all usual and customary safety practices will be implemented to insure safety of workers.	Fire Management Office and/or Contracting Officer
Ecological Function	The specifications for the reduced fuel buffer will result in fuel and forest canopy conditions closely resembling those desired for restoring natural conditions. The creation of a defensible buffer will allow future implementation of more widespread restoration of fire as an ecosystem process on adjacent NPS lands.	Park project manager will insure work conforms to specified standards.
Aesthetics	High fuel levels and dense thickets of trees will be reduced to natural levels. These conditions create a more open understory, a condition that is also attractive to many residents and visitors. The developed areas will blend more seamlessly into the natural environment more readily. Stumps will be flush cut and cut ends of logs will be treated to reduce visibility.	Park project manager will insure work conforms to specified standards.
Special Status Species	No special status wildlife or plant species will be affected.	N/A
Water and Wetlands	The use of vehicles in or around stream corridors will be prohibited. No soil disturbance will occur. Logs and other large woody debris over eight inches in diameter will remain in the streambeds and throughout the project area.	Park project manager will insure work conforms to specified standards.
Cultural Resources	The park archeologist will monitor ground-disturbing activity. Park staff overseeing the project will be trained to identify potential resources encountered. Any cultural resources detected will be avoided or fully mitigated to standards established by the park	Park Archeologist

Resource Value	Mitigation	Responsible Party
	archeologist prior to work being continued.	
Wilderness	No vehicles will be used within the wilderness at Oriole Lake and all minimum tool requirements specified in the Assessment will be adhered to during implementation. The conditions created by the project will result in an area that will more closely resemble natural conditions. Creation of the reduced fuel buffer around the developments will result in conditions favorable to the reintroduction of fire and restoration of more natural conditions in the surrounding NPS wilderness areas.	Park project manager will insure work conforms to specified standards.
Air Quality	Air quality impacts in localized areas will occur because of the prescribed burning. All burning will be conducted in strict conformity with the requirements of the San Joaquin Air Pollution Control District. Burning will occur after Labor Day or before Memorial Day to minimize the numbers of visitors and residents exposed to smoke. Residents and visitors will be notified in advance of burning so they may avoid the smoke.	Fire Management Officer
Recreation	Project areas may be closed for short duration (1 hour to 1 week) to facilitate safe operations. Closures will be affected for the minimum amount of time necessary for safe operations. No public roads or trails will be closed. Areas will be restored to more natural appearance and function, enhancing the recreational experience.	Project manager in conjunction with area Rangers.

PUBLIC AND PERSONNEL SAFETY

Job Hazard Analysis (JHA) will be reviewed by project staff prior to the start of any new work on the project. Existing JHA's that can be used for chainsaw work (falling, bucking, limbing, sharpening), slash piles, environmental hazards and driving on narrow park roads are located on the parks network and will be made available to project crews. If the project has the potential to impact the traffic on the Mineral King road, traffic control will be in place with confirmed communications on both ends. Emergency Medical Technicians (EMT's), first responders, or first aide personnel will be identified in the field for each day of work as well as the procedures for medi- vac.

INTERAGENCY COORDINATION AND PUBLIC INFORMATION

1. Employee and Public Information Outreach Procedure:

The fire information officer will coordinate public information for park visitors, park employees, and local communities. Special coordination will occur with the Mineral King

interpreters, Mineral King Rangers, District Fire Management Officer, Project Lead, and the local cabin owners association.

2. Notification of District and Fire Management Staffs about Preparation and Execution Procedure:

Sequoia district and Mineral King sub- district staff will be kept up to date about progress made concerning project execution, rehabilitation, and monitoring.

3. Fire Dispatch Situation Update Procedure:

Fire dispatch will be updated on the project status every day that personnel are on site, from preparation through execution, rehabilitation and monitoring phases.
All resource orders will be placed though fire dispatch. Fire dispatch will be kept informed about staffing, activity, and any problems relevant to the project on a daily basis.

MONITORING AND EVALUATION

A. A permanent plot will be installed approximately every 5 chains along the outside edge of the thinning project, starting approximately 5 chains in from the Mineral King Road, looking back in towards the developed area. Previous experience has shown that 15- 20 sample points will generate adequate data to represent the area statistically. The sampling intensity indicated above should yield the desired number of sample points. The sample point will be marked by a single rebar stake, that will be painted orange to facilitate relocation. The rebar stake will have a tag that identifies the project name (Silver City Thinning) and plot number.

   A photo series estimate of the total woody fuel load will be taken from this point looking back into the project area with the plot centerline being perpendicular to the outside edge of the project (see plot diagram). The photo series estimate will go out from the sample point at 45° angles from either side of the stake out for 100 feet. The total fuel load estimate will be recorded along with the plot number.

   At 100 feet in to the project area along the plot centerline, a chaining pin will be placed into the ground. A tape measure will be swung around this chaining pin for a radius of 100 feet. All trees less than 40 feet tall within this radius will be recorded. Trees that are close to 40 tall will be measured using a clinometer and tape, to accurately estimate the tree height.

B. The plot will be reread, immediately following the completion of the project to determine if the objectives have been met, and then again on a10 year basis to determine a maintenance schedule. When the total woody fuel loading exceeds 12 tons/acre, additional piling of fuels and burning of the piles will occur. When the total number of trees less than 40 feet tall exceed 25/acre, additional thinning, piling and burning will occur. When maintenance activity occurs, the plots will be reread to assure the treatment objectives are being met. The area will be maintained into the future so that the project objectives are met.

C. Up to 3 standard fire effects monitoring plots will be installed within the project area in order to compare results to those from similar areas treated with prescribed fire. Although only limited information will be gained from such a small sample size, differences in understory composition and patterns may be documented and investigated further if necessary. Fuel accumulation rate and tree regeneration will also be documented in the plots. Protocols will follow those outlined in the NPS Fire Monitoring Handbook and SEKI FFMP Monitoring Plan.

D. Due to concerns about the potential for non- native plant invasion into disturbed areas, directed surveys may be conducted in the treatment area. With assistance from the parks' exotic plant program staff, the status of pre- treatment presence of non- native plant species will be determined along with any changes that may occur 1 and 2 years following initial treatment and after further treatment.

POST PROJECT REHABILITATION

All trails and roadways near the project area will be surveyed after the completion of the project for hazards caused by the operation. All identified hazards will be mitigated as soon as possible. All saw cuts will be flush- cut and cuts will be buried or disguised. Fire lines constructed within the project area will be established using minimum impact suppression techniques, and be rehabilitated per the guidelines contained within the Fire and Aviation Management Operations Guide (FAMOG).

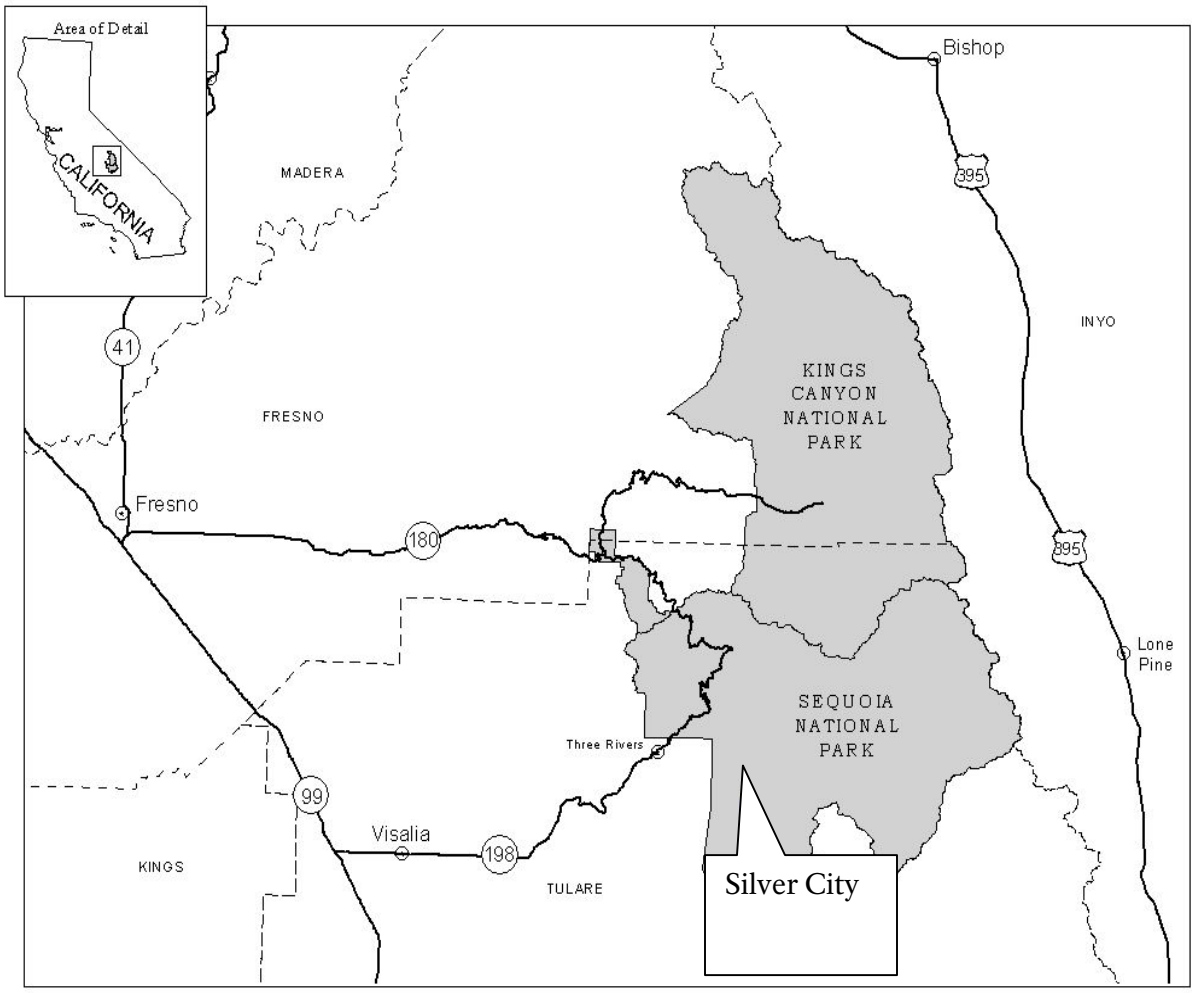
POST PROJECT REPORTS

Fire Dispatch will maintain a project file with dispatch log, resource orders, OF- 288 and CTR forms, and project plan, Unit Logs.

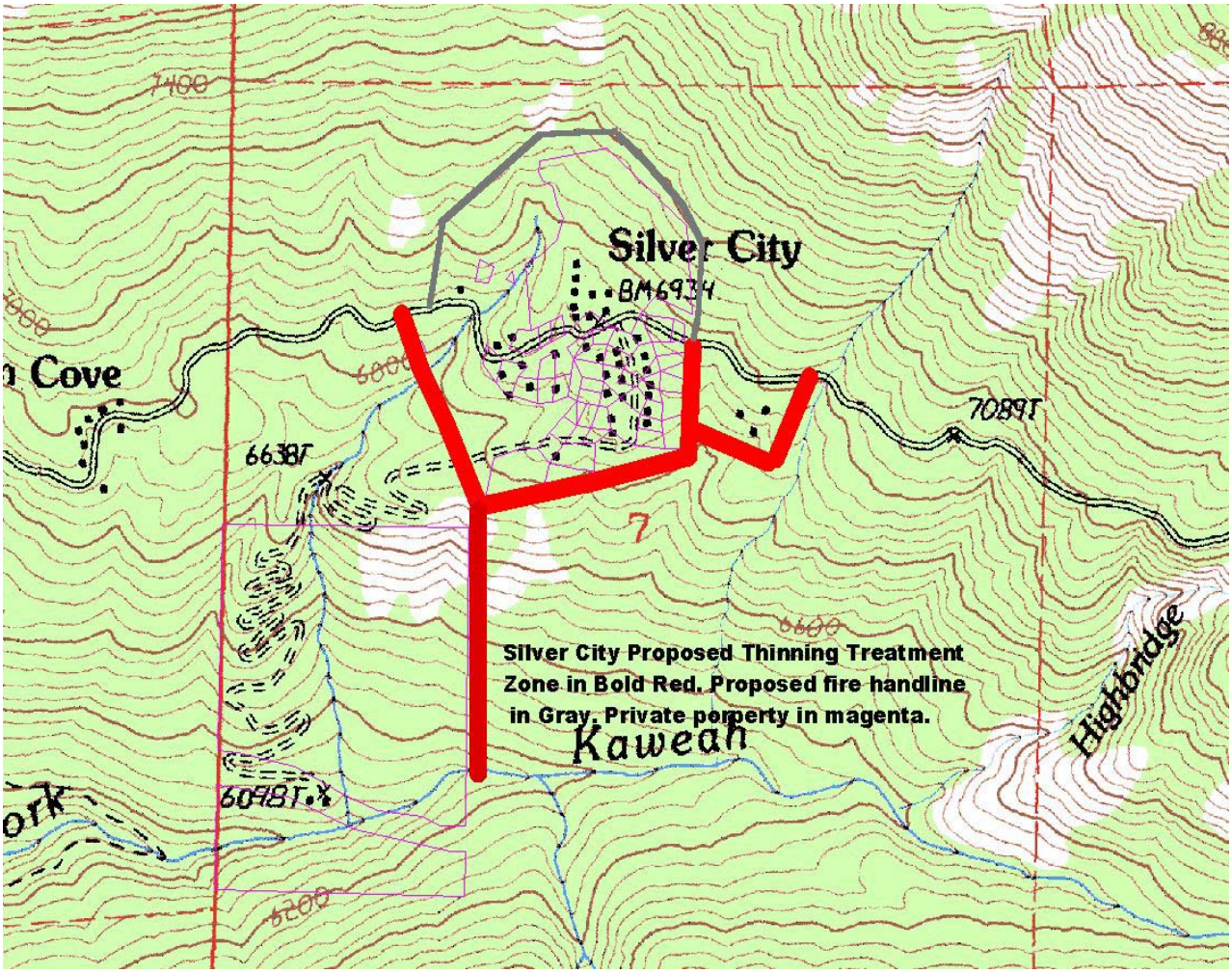
The Project Lead will maintain ICS- 214 Unit Logs.

The Project Lead will report to the park archaeologist the discovery of cultural artifacts.

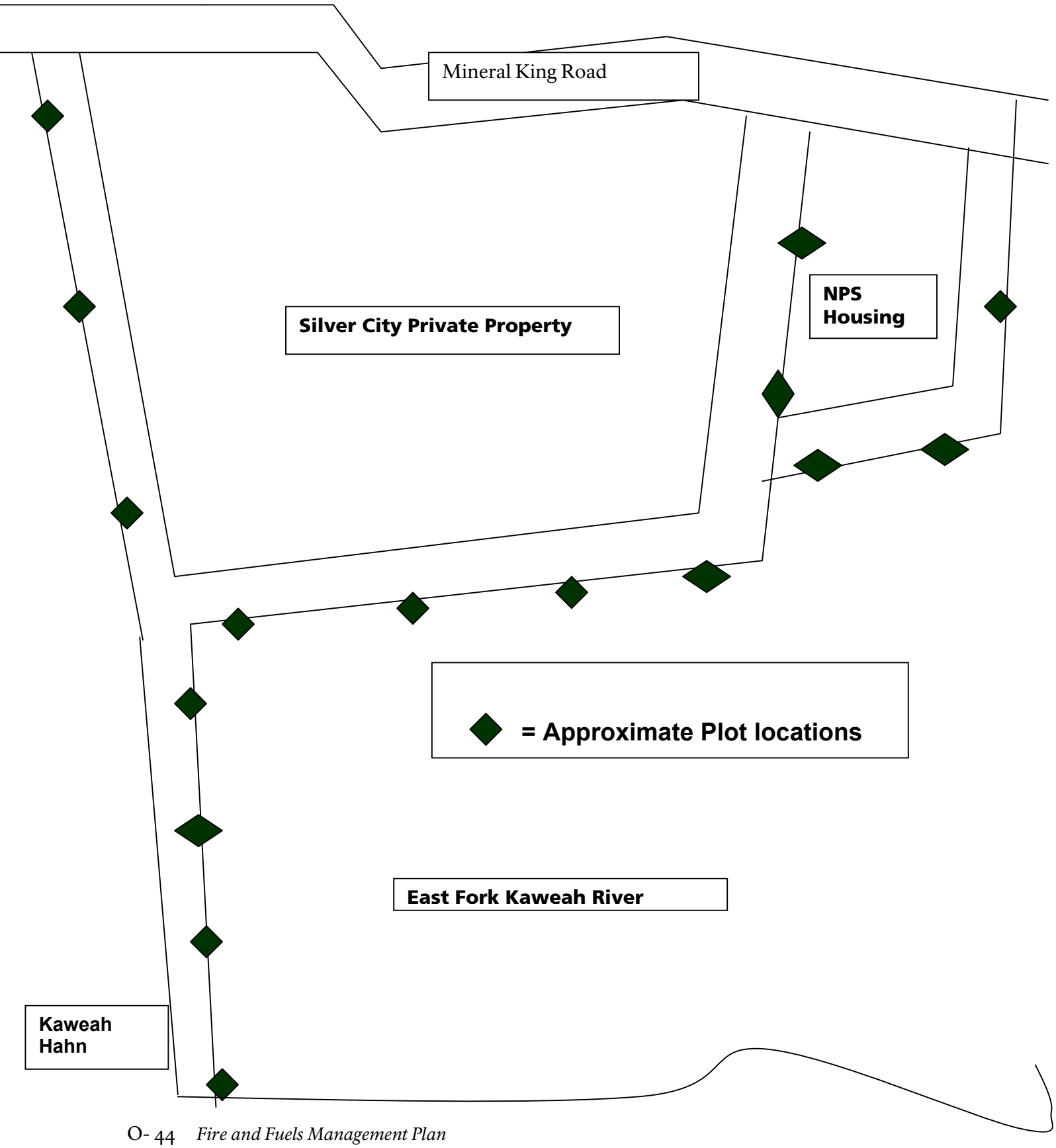
VICINITY MAP



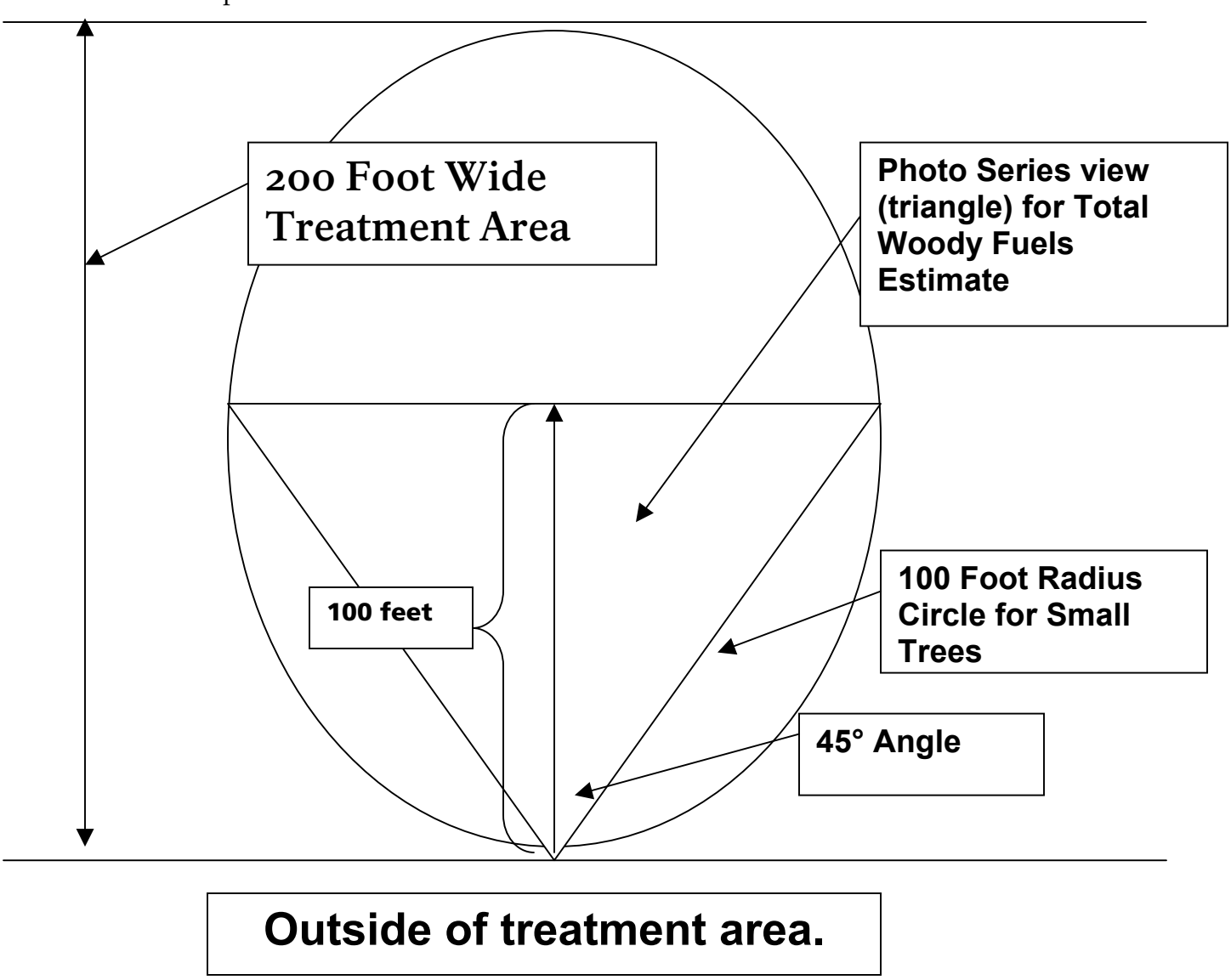
PROJECT MAP


Silver City
BM6934
Cove
6638T
7089T
7
6600
Silver City Proposed Thinning Treatment
Zone in Bold Red. Proposed fire handline
in Gray. Private property in magenta.
Kawean
Highbridge
6098T
6200

PLOT DIAGRAM



PLOT DETAIL


Area to be protected
200 Foot Wide Treatment Area
Photo Series view (triangle) for Total Woody Fuels Estimate
100 feet
100 Foot Radius Circle for Small Trees
45° Angle
Outside of treatment area.

PARK REVIEW COMMENTS

Project Name: __**Silver City Manual Fuels Treatment**___

Please note comments you have concerning this project plan.

Fire Management Officer:

Division of Visitor and Fire Management:

Division of Science and Resources Management:

Division of Cultural Resources and Interpretation:

Superintendent:

Other:

P - Preparedness Staffing Plan

STAFFING LEVEL I

Ash Mtn. Area	Grant Grove/Lodgepole Areas	Cedar Grove Area
BI 0- 51	ERC 0- 36	BI 0- 34

Staffing

- Normal tours of duty and number of fire crew personnel.

Operations

- Entrances – Fire danger rating and road signs reflect the highest adjective class reported.
- All Fire Crews- Maintain readiness.

STAFFING LEVEL II

Ash Mtn. Area	Grant Grove/Lodgepole Areas	Cedar Grove Area
BI 52- 144	ERC 37- 54	BI 35- 47

Staffing

- Normal tours of duty and number of fire crew personnel.

Operations

- Entrances – Fire danger road signs reflect the highest adjective class reported.
- All Fire Crews – Maintain readiness.

STAFFING LEVEL III

Ash Mtn. Area	Grant Grove/Lodgepole Areas	Cedar Grove Area
BI 145- 219	ERC 55- 72	BI 48- 64

Staffing

- Normal tours of duty and number of fire crew personnel.

Operations

- Entrances – Fire danger rating road signs reflect the highest adjective class reported.
- All Fire Crews – Maintain readiness.

STAFFING LEVEL IV

Ash Mtn. Area	Grant Grove/Lodgepole Areas	Cedar Grove Area
BI 220- 240	ERC 73- 77	BI 65- 69

Staffing

- Extended hours and increased staffing for all fire crews will be authorized by the Duty Officer.
- All fire crew members may work their sixth day.
- All fire crews may augment crew staffing with 2 additional firefighters.

Operations

- If extended periods of high staffing levels occur then fire staff will review the need for implementing fire use restrictions.
- Entrances – Fire danger rating road signs reflect the highest adjective class reported.
- All Fire Crews – Maintain readiness.
- New slash pile burns are prohibited.

STAFFING LEVEL V

Ash Mtn. Area	Grant Grove/Lodgepole Areas	Cedar Grove Area
BI 241+	ERC 78+	BI 70+

Staffing

- Extended hours and increased staffing for all fire crews will be authorized by the Duty Officer.
- All fire crew members may work their sixth day.
- All fire crews may augment crew staffing with 2 additional firefighters.
- May order cover engines for any engines off- park. Consult with park FMO and Duty Officers.

Operations

- If extended periods of high staffing levels occur then fire staff will review the need for implementing fire use restrictions.
- Entrances – Fire danger rating road signs will reflect the highest adjective class reported.
- All Fire Crews – Maintain readiness.
- New slash pile burns are prohibited.

(2003 version)

Q - Wildland Fire and Fuels Management Reporting Requirements

y- 14

Memorandum

To: Burn Bosses & Fire Monitors

From: Prescribed Fire Technician

Through: Fire Management Officer

Subject: Prescribed Fire Operations Documentation
Paperwork Reduction

ANNUAL PRESCRIBED FIRE PROGRAM DOCUMENT

Two or three prescribed fire planning meetings are held each winter – one for Kings and Sequoia Districts and one with Forest Service personnel. The information gathered in the planning meetings is presented in the annual SEKI prescribed fire program document which is used as a basis for annual proposed program review by the park management team and approval by the superintendent. Copies are distributed to area supervisors and Burn Bosses. Detailed descriptions of the units and maps are included along with operational issues identified in the planning meetings.

PRESCRIBED FIRE OPERATIONS DOCUMENTATION

Burn Boss Responsibilities

Burn Bosses are responsible for completion of Burn Unit Plans, Unit Logs, Individual Fire Reports (DI- 1202), and performance ratings. Cost tracking forms and Post Burn Reports are no longer required. Burn Bosses need to make sure that unit preparation and execution support is coordinated with District Rangers and FMO, and that adequate documentation is provided to Fire Dispatch during burn unit execution. Burn Bosses will provide daily fire situation updates to Fire Dispatch by radio, telephone, fax, or email.

Burn Unit Plan – One plan should be written for all "active" segments within a unit – this saves on duplication of effort and time spent getting the document reviewed and approved. The plan is good until all segments are executed or there are major changes in unit/segment planning. The Burn Boss has the final say on control line location. New prescriptions are being developed for long duration burns – the prescription will be weighted on climate conditions and fuel moisture.

For short duration burns the current prescriptions are valid. A burn plan form is available on the park network under J:/share_docs/plans/fire/burn_plans. There are significant changes to the form based on new permitting requirements enforced by the San Joaquin Valley Unified Air Pollution Control District. Burn Bosses must use this new form from now on.

Unit Log – For use in tracking decision and significant actions/events during execution. Attach originals to Individual Fire Report and send to FMO.

Individual Fire Report – For NPS reporting purposes, geographically distinct segments within a unit need to be documented on separate Individual Fire Reports. We tried to reduce workload by combining segments into one report but were advised by NPS Boise that we need to separate them in order for SEKI to receive full funding for the fire program.

- Thorough Individual Fire Reports take the place of Post Burn Reports and narratives should be detailed.
- Provide a chronological narrative of events and decisions.
- Use the monitoring data collected to compare what actually happened on the fire to burn unit objectives. Describe, based on monitoring data and your experience, how the fire met objectives. If objectives were not met, explain the problems encountered that prevented meeting objectives.
- Attach 7.5 minute maps showing daily fire spread or ignition information, and final fire perimeter.
- Unit Log originals should be included with Individual Fire Reports and sent directly to Fire Dispatch within 10 days after declaring the fire out.

Trainee Performance Ratings – Burn Bosses are responsible for completion of Individual Performance Ratings (ICS Form 226) or Task Books for trainees. Task Books are initiated through coordination with FMO.

Fire Monitor Responsibilities

Fire Monitors – Fire monitor reports with lengthy narratives are no longer required by FMO – summaries used for programmatic analysis by FMO will be initiated at RMO discretion. Fire Monitors need to gather thorough observation information on several forms and maps are prepared for all prescribed fire incidents they are assigned to (see list below). If designated Fire Monitors are not assigned to a burn unit then it is the Burn Boss' responsibility to thoroughly document burn unit execution using the same forms. Monitors need to provide copies of all forms to Burn Bosses within a timely manner. All original forms and maps are sent to Fire Dispatch for inclusion in the fire files. Monitors on fire (typically prescribed fire or fire use projects) where there is not a Burn Boss on site will update Fire Dispatch daily with information based on the Wildland Fire Record form by radio, telephone, fax, or email.

Fire Effects Monitors – Fire effects monitoring protocols are supervised by one park fire ecologist. Plots records remain with the ecologist. FMO works with the ecologist to archive fire effects records.

Smoke and Weather Monitoring Technician – The Smoke and Weather Monitoring Technician compiles data from various observation sensors, archives the data and compiles hard copies into data packages for several prescribed fire operations each fire season.

List of Monitoring Forms (items 1- 5 available from FMO)

1. Dead Fuel Moisture Determination
2. Live Fuel Moisture Determination
3. Fire Weather and Fire Behavior Observations
4. Smoke Observations
5. Wildland Fire Observations Record
6. Maps showing daily fire spread or ignition, and including locations of fire observations.

Fire Dispatch Responsibilities

Fire Dispatch is responsible for compiling fire planning documents, situation and observation data into individual fire files, and documents fire situation information using the form: Interagency Report of Incident and Dispatch Action. Fire Dispatch also maintains daily fire situation information in several interagency computer systems.

Fire Information Officer Responsibilities

The Fire Information Officer is responsible for compiling media releases and news articles about fire operations and sending copies to Fire Dispatch. The FIO also coordinates communications about park fire operations with employees through use of email systems.

REPORTS

The Fire Management Office is responsible for completion of the following:

1. Annual prescribed fire accomplishment reports into the NPS Wildland Fire Management Computer System (WFMCS)
2. Entering Individual Fire Reports in WFMCS
3. Annual SEKI Fire Summary
4. Annual SEKI Air Operations Summary

ARCHIVES

The Park Archaeologist supervises the archiving of individual fire files and other important fire history documents into park archives. FMO staff prepares the files following the archaeologists direction.

R - Fire Staffing & Minimum Qualifications

The following list is intended to be the park- wide minimum qualifications staffing that supports the average annual on- park fire work load. The list does not include career development, off-park support or special assignments—except for Arrowhead Hotshots.

Functional Area	Minimum	Who?
Command		
FUMA	3 from the following list	FMO / DFMOs / RX Spec. / Fire Planner
ICT3	3	FMO / DFMOs
ICT4	9	All Hand Crew and Engine Crew Captains and Helicopter Managers on the HELITACK Crew
ICT5	13	All fire crew first line supervisors, C-91 Squad Bosses, and Helicopter Managers on the HELITACK Crew
IOF3	2	PIO / FIO
RXB1	4 from the following list	FMO / DFMOs / RX Spec. / Fire Planner
RXB2	10 from the following list	FMO / DFMOs / RX Spec. / Fire Planner / All STF Engine Captains / C-91 Leader / Fire Monitor Squad Leader / H-552 Captain
RXM1	3 from the following list	FMO / DFMOs / RX Spec. / Fire Planner
RXM2	3 from the following list	FMO / DFMOs / RX Spec. / Fire Planner
Finance		
EQTR	1	FMO Budget Assistant
PTRC	4	Kings Dist. Ranger Time Keeper / Sequoia Dist. Ranger Time Keeper / FMO Budget Asst. / A- 6 Clerk
TIME	1	FMO Budget Asst.
Logistics		
ORDM	1	Fire Cache Manager
RCDM	1	Fire Cache Manager
Operations		
AFUS	3	H-552 Captain and Helicopter Managers on the HELITACK Crew
CRWB	5	Crew 91 Leader / H-552 Captain and Helicopter Managers on the HELITACK Crew / Fire Monitor Squad Leader

DIVS	4	FMO / DFMOs / RX Spec.
ENGB	6	All Engine Captains, Asst. Engine Captains
FALB	13	2 on each engine / 6 on C-91 / 3 on HELITACK / 3 on the monitoring squad
FALC	9	All Engine Captains / Crew 91 Leader and Squad Bosses/ H-552 Captain
First Responder	7	All STF Engine Captains / H-552 Captain and Helicopter Managers on the HELITACK Crew / C-91 Leader and Squad Bosses
HEB2	2	DFMO Sequoia / H-552 Captain
HECM	5	H-552 Crew
HEMG	3	H-552 Captains and Helicopter Managers on the HELITACK Crew
RXI1	5	FMO / DFMOs / RX Spec. / Fire Planner
RXI2	10 from the following list	FMO / DFMOs / RX Spec. / Fire Planner / All STF Engine Captains / C-91 Leader / Fire Monitor Squad Leader / H-552 Captain
STAM	4	A-6 Clerk / Procurement / Maintenance
Planning		
FBAN	1	RX Spec.
FEMO	5	Fire Monitor Squad
LTAN	1	RX Spec.
SCKN	4	Kings Dist. Ranger Time Keeper / Sequoia Dist. Ranger Time Keeper / FMO Budget Asst. / A-6 Clerk
Arrowhead Hotshots		
CRWB	5	Superintendent 6 / Foreman (2) / Module Leader (2)
EMT-B	2	Skilled Firefighter / Crew Member FALC
FALC	3	Foreman / Module Leader / Skilled Firefighter
FFT1	5	Skilled Firefighter (5)
FFT2	10	Crew Members
HECM	2	Skilled Firefighter / Crew Member
ICT3	2	Superintendent 6 / Operations Foreman
ICT4	3	Logistics Foreman / Module Leader (2)
ICT5	5	Skilled Firefighter (5)
STCR	2	Superintendent 6 / Operations Foreman

S - Yearly Readiness Checklist

This checklist is a summary of all pre- suppression activities.

YEAR- ROUND
Return any and all defective equipment to the Ash Mountain cache.

JANUARY
- Issue Forestry Technician seasonal job announcement.
- Determine in- park fire training needs and establish training dates. This includes basic training (S- 130, 190, 211, 212, and the 8hr. refresher).
- Continue Ash Mountain Fire Cache and vehicle inventory requisition and replacement of equipment and supplies.
- Complete previous years data summary reports for fire monitoring.
- Update fire history and 1202 database in GIS.
- Complete all annual fire repots and required reports.

FEBRUARY
- Rate Forestry Technician applications.
- Follow up with chainsaw maintenance facilities.
- Begin engine pump tests with Tulare County Fire.

MARCH
- Begin seasonal hiring process. (Firefighters and Fire Monitors)
- Schedule wildland fire physicals for employees with primary firefighting responsibilities who require an update.
- Begin work capacity testing (pack test).
- Re- inventory Ash Mountain Fire Cache.
- Complete engine pumps test.
- Conduct annual winter fire operations meeting.

APRIL
- Continue seasonal hiring process.
- Continue pack testing.
- Coordinate operations meetings with local cooperators.
- Begin clean- up, maintenance, servicing and restocking of all engine fire patrol vehicles.
- Continue inventory of Ash Mountain fire cache and restock if necessary. Prepare for summer issues.
- Test pumps and chainsaws prior to crew issue.
- Activate the Ash Mountain weather stations and begin collecting observation.

MAY

- Continue seasonal hiring process.
- Early May – EOD of engine, handcrew, and helicopter crewleaders.
- Conduct one 8- hour refresher course for crew leaders and permanent fire staff.
- Late May – EOD of all crew members.
- Continue clean- up, maintenance, servicing, and restocking of all engines and patrol vehicles.
- Ash Mountain Cache – Begin summer issue of PPE and crew equipment.
- Conduct annual pre- season supervisory ranger and engine crewleader operations meeting.
- Begin daily vehicle readiness checks as per FAMOG.
- Begin mechanical hazard fuels reduction projects.
- Prescribed burnings of approved units in prescription.
- Activate the Ash Mountain Helibase.
- Prescribed burn plans completed for Superintendent's signature.
- Rehires submit updated red card information. (experience/training)
- Activate Cedar Grove manual fire weather station and begin collecting observations.
- Begin collecting fire weather observations and calculating fire danger ratings.
- Begin or continue a physical fitness program and continue all year.

JUNE

- EOD of the park contract helicopter.
- New hires submit red card application information (experience/training).
- Red cards issued.
- Complete all required pre- season wildland fire training (S- 130, 190, 211, 212, and the 8- hour refresher) including Basic Aviation Safety.
- Begin daily individual firefighter personal protective equipment checks as per FAMOG.
- Each crew to begin and maintain a daily station log.
- Begin fuel moisture sampling (as required, ongoing).
- Establish additional fuel loading plots (as required, ongoing).
- Complete all non- fire related training (POSH, defensive driving, SEKI orientation, Update training, etc.)
- Complete engine, patrol vehicle, and station inventory and restock as necessary.
- Begin season- long proficiency training as per the 1998 readiness review standards.
- Continue mechanical hazard fuel reduction projects.
- Prescribed burn preparation activities.
- Prescribed burning of approved units in prescription.
- Activate all sub- district helispots.
- Conduct fire hydrant flow tests as per FAMOG.

JULY

- Continue mechanical hazard fuel reduction projects.
- Pressure test fire engine and patrol vehicle primary hose and all structure fire hose per FAMOG.
- Prescribed burn preparation activities.
- Prescribed burning of approved units in prescription.
- Continue fire hydrant flow tests.

- Continue fuel moisture and fuel loading sampling.
- Conduct employee fire extinguisher use training.
- Conduct weekly and/or daily training sessions on safety, engine operations, chainsaws, portable pumps, and helicopter use.
- Complete Readiness Review.

AUGUST
- Continue daily fire readiness check of vehicles, equipment, and PPE.
- Continue daily and weekly informal training.
- Continue proficiency training.
- Continue mechanical hazard fuel reduction projects.
- Prescribed burn preparation activities.
- Continue fuel moisture and fuel loading sampling.
- Prescribed burning of approved units in prescription.

SEPTEMBER
- Continue daily fire readiness check of vehicles, equipment, and PPE.
- Continue daily and weekly informal training.
- Continue proficiency training.
- Continue mechanical hazard fuel reduction projects.
- Prescribed burn preparation activities.
- Continue fuel moisture and fuel loading sampling.
- Prescribed burning of approved units in prescription.

OCTOBER
- Continue daily fire readiness checks of vehicles, equipment, and PPE.
- Continue daily and weekly informal training.
- Continue mechanical hazard fuel reduction projects.
- Prepare end- of- season crew report as per FAMOG.
- Winterize all sub- district helispots.
- Continue fuel moisture and fuel loading sampling.
- Complete fuel loading data entry.
- Re- inventory engines, patrol vehicles, and station facilities. Prepare deficiency list for replacement items.
- Attend annual end of season operations meeting.
- Prescribed burn preparation activities.
- Prescribed burning of approved units in prescription.
- Begin end- of- season vehicle and power equipment winterizing.
- All fire crew leaders- submit updated experience and training (EZ form) to fire dispatch for yourself and your crewmembers.

NOVEMBER
- Prescribed burn preparation activities.
- Prescribed burning of approved units in prescription.
- Continue winterizing all patrol vehicles, pumps, chainsaws, and PPE.
- Final closure of station facilities.

- Perform quality checks of fuels data.
- Prepare and submit monitoring crews annual reports.

DECEMBER
- Send out chainsaws/pumps for maintenance.
- All 1202's (Fire Reports) completed and entered in SACS.
- Prepare requisitions for Ash Mountain Fire Cache and vehicle inventory restocking.
- Analyze and summarize fuel loading data collected during the season.

T - Addendum

1. Suppression Fire Response Plan

2. *Logistics Plan*, Sequoia and Kings Canyon National Parks. In development/draft 2002. Located in Fire Management Office.

3. *Fire and Aviation Management Operations Guide,* Sequoia and Kings Canyon National Parks. 2001. Located in Fire Management Office.

4. Letters of Agreement (LOA) and Memorandums of Understanding (MOU) binder

5. *Wildfire Prevention Plan: An Operating Plan of the Park Fire Management Program*, Sequoia and Kings Canyon National Parks. 1993. Located in Fire Management Office.

6. *Risk Management Plan*, Sequoia and Kings Canyon National Parks. 1998. Located in park Safety Office.

7. Wildland and Prescribed Fire Management Policy Implementation Procedures Reference Guide

8. *Aviation Management Plan*, Sequoia and Kings Canyon National Parks. 2001 (Draft). Located in Fire Management Office.

9. Standard Operating Procedures for the Communication Center

10. Emergency Equipment Rental Agreement binder

11. *Draft Programmatic Minimum Requirement / Minimum Tool (MR/MT) Compliance Agreement*, Sequoia and Kings Canyon National Parks, February 27, 2003.

12. *Standard Operating Procedures: Fire & Fuels Information, Sequoia & Kings Canyon National Parks.* Located in the Fire Information and Education Specialist's office.